the OIL AND GAS JOURNAL
DECEMBER 2, 1957

Early LPG Flood Runs Into Trouble

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How Sunray Plans to Grow Its Own Bosses

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✓ How 31 Refineries Condition Cooling-Water Systems

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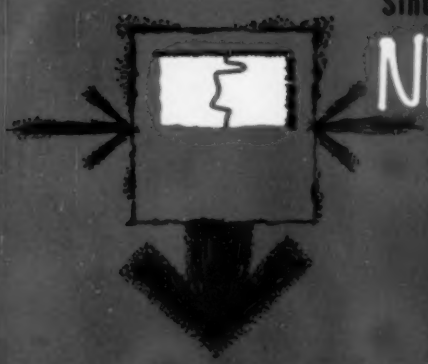

Sinclair Develops

NEW GRAVITOMETER

. . . . automatic blending of crudes to constant gravity

p. 78

IN Wyatt's DALLAS PLANT

Equipment for Caps and Trays
Whatever the Design — Whatever the Alloy.

Wyatt's
HOUSTON-DALLAS-NEW YORK-TULSA

Wyatt's Plastics, Inc.
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MANUFACTURERS AND ERECTORS
SINCE 1913

the OIL AND GAS JOURNAL Newsletter

Tulsa, Okla.
Dec. 2, 1957

Miscible-phase displacement may be tougher to handle in actual field operations than some figured.

That's one indication emerging from Sun's experience in Millican Reef field of Coke County, Texas. The miscible front here lasted only 4 to 6 months and swept only 15 to 20 per cent of the pilot reservoir.

Best guess as to what caused the disappointment: Not enough propane was injected (p. 59).

Canada's natural-gas reserves should be boosted to at least 74 trillion cubic feet over the next 25 years, compared with today's 24 trillion.

British American's senior vice president, E. D. Loughney, makes the estimate and says the reserves will be enough to supply Canada's aggregate domestic needs for the 25 years and have 47 trillion left over. That's enough to supply Canada for another 40 years at the 1980 rate.

Loughney then makes this point: Unless adequate export markets are developed without further delay, many companies will have to cut back operations. Without exports, Canada's natural-gas industry will never mature.

Western Canada has its first show of Ordovician oil. It could open new horizons for oil hunters in Saskatchewan.

The indicator is the Hummingbird 6-13-2-19, just north of the Montana border. Imperial recovered 240 ft. and 765 ft. of oil in drill-stem tests covering 47 ft. of Ordovician section at 9,848-75 ft. and 9,875-95 ft. respectively.

If successful, the well could mean the start of new deep pre-Mississippian drilling throughout Saskatchewan's share of the Williston basin (p. 149).

Upcoming state legislative sessions will tie into many weighty oil issues. Two of them, New York and Pennsylvania, will consider complete conservation bills.

New York's legislative council has drafted a bill based on the Interstate Oil Compact's so-called model statute. The state, though an oil pioneer, has little oil regulation.

Interest in bidding on California tideland leases is still good. This is true despite uncertainty of bidding techniques and royalty rates yet to be set.

Evidence of interest:

...At least two core boats are working on 54,000 acres now being processed for bidding by State Lands Commission.

...Texaco confirms it is dickering with Global Marine Drilling to use the CUSS I barge on a coring program. Area where Texaco wants to drill is north of Los Angeles County.

Indications are commission will reveal new lease terms by Christmas. Oil companies fear new rules could wreck the state's offshore development. Commission staff members say privately, however, the state won't price the tidelands out of the market.

The industry can look for lower fourth-quarter earnings: The reasons, according to one top executive: strict production allowables, lower consumption than expected, and high wages. The downward profit trend follows a good first half and a so-so third quarter.

Next year: product demand should rise a little.

A trend toward natural-gas air conditioning may be developing.

Encouraging news comes from Carrier, one of the big names in air conditioning. Company has now come out with a unit that will operate on gas.

Arkansas Louisiana Gas Co. not long ago bought Servel Air Conditioning Division in an aggressive move to offset competition of the electric industry. Arkla intends to put real push into a sales and development campaign.

Stakes are high for gas air conditioning. If gas distributors can develop a really big market, they will solve one of the industry's headaches: Low summer demand.

California's first platform-type drilling structure for offshore use is under construction this week.

Schedule calls for first drilling by July 1 by Standard of California and Humble on 5,500-acre state lease 2 miles off Summerland.

The 175-ft. tall platform is under construction at San Diego shipyard and should be completed by May 1 for towing to anchorage in 100-ft. water. A three-level drilling deck, 100 ft. square, will be added. It will hold 25 wells, allow two to be drilled at a time. Estimated cost: $2.3 million.

Gas turbines are still getting a hard look from the automotive industry, although development has come much slower than was once anticipated.

Ford Motor Co.'s advanced truck research group is "completely researching" the gas turbine. Use of the turbine in trucks would increase uphill speed and acceleration so

they can keep up with normal traffic flow. It would reduce traffic congestion and thus be a boon to all.

The Gulf Coast's refining capacity should rise by 26 per cent in the next 8 years. But—the area's share of total domestic runs will decline from 33½ per cent to 30 per cent.

This is the forecast of Conoco's Vice President John McLean. Reason for the percentage decline: increasing dependence of Gulf Coast refiners on foreign oil.

Alkylation of ethylene may result if future demand for high-octane alkylates lives up to expectations.

Most alkylation units to date have used butylenes and isobutane. Substantial quantity of pentylenes have been alkylated along with some propylene.

The expectation that enormous quantities of alkylate will be needed in the future means greater volumes of propylene and then ethylene alkylation.

Future petrochemical plant development may avoid the Houston Ship Channel area unless Harris County alters its pollution control policies.

One executive contends a county pollution control unit is harrassing industries with both criminal and civil lawsuits. Adverse effect of the suits is compounded by publicity issued before the companies are formally notified of the legal action taken.

The same executive says he couldn't conscientiously recommend to a friend that he consider locating a new plant in Harris County under present conditions.

Refiners will be interested in Skelly's processing plans for the unifining unit at its Longview, Texas, refinery.

The unifiner will be used to process a heavy thermal-unit naphtha cut which then will be satisfactory for platformer feed. The net result will be an increase in reformer feed and an improvement in thermal-unit blending stock.

A new gravitometer developed by Sinclair makes possible the automatic blending of two crudes to constant outgoing gravity. It responds to gravity changes in 35 seconds, compared with 15 minutes for existing instruments. It's also two to three times as sensitive and accurate (p. 78).

Sinclair has proved the instrument on its system in the Chicago area.

One national organization has gone on record against the Government's import-control program. The National Foreign Trade Council adopted a resolution in New York asking the Government to avoid "trade policies which make the importation of essential raw materials more difficult or costly."

Profits must remain at present levels if the growth of 10 per cent per year for synthetic organic chemicals is to hold for the future.

This is the warning given last week at the Manufacturing Chemists Association meeting in New York by Dow Chemical's Donald K. Ballman.

Says Ballman: If profits shrink, the industry cannot continue spending large sums for research and development. Despite lower prices for mass-produced chemicals, mostly of petroleum origin, profits have held up because research has paid off continually with new products.

Today's gross value of Universal Oil Products Co. is estimated at $50 million—give or take a few million.

The estimate was given by attorneys for Guaranty Trust Co., which stands to get $5 million from a proposed stock sale if its bid for 10 per cent compensation is sustained by the courts. The sum would be in addition to Guaranty's annual $50,000 compensation, received since 1944.

Venezuela's Boscan crude, once an outcast, is coming into its own (p. 76).

Richmond Exploration was the first to find markets for heavy and viscous Boscan, and now Shell is stepping up production. The field, on the west side of Lake Maracaibo was discovered in 1951 but only now is being actively developed.

A Bolivian concession of 2,223,900 acres may be awarded shortly to three independent U. S. oil companies. The companies will pay no bonus but must meet specified exploratory obligations.

The companies: White Eagle International Oil Co., the operator, Blackwell Oil & Gas Co., and Western Hemisphere Petroleum Co. (p. 76).

Japanese are warming up to the idea of buying Russian oil. Four firms now have agents dealing with Moscow.

Soviets have rejected preliminary Japanese proposals to buy 630,000 bbl. a year as too small to bother with. Soviet price reportedly is $2.43 a bbl. for 30-50°-gravity oil f.o.b. Batum or Odessa on the Black Sea.

A wider use has been discovered for the wire-line formation tester, used originally only for unconsolidated Gulf Coast sands.

Schlumberger Well Surveying Corp. has redesigned the tool for use in medium and hard formations of the Mid-Continent (p. 120). Three months of field tests in Oklahoma show these advantages over drill-stem tests: it's faster and safer, it can penetrate the invaded zone, it samples actual fluid content of the zone, and it can test within a few inches of the desired level.

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the OIL AND GAS JOURNAL

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OIL AND GAS PIPELINES • REFINING • PETROCHEMICALS
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TECHNOLOGY—OPERATION

Refining-Processing

Butylene Dehydrogenation by the Steam-Dilution Method 87

By John C. Reidel

This is today's basic method for commercial production of butadiene from butylenes. But different results may be obtained with different catalysts. Currently there is great activity in catalyst development. Part 2 of a five-part series.

Nelson Refinery Construction Index 95

How 31 Refineries Condition Cooling-Water Systems 101

By J. D. Helwig and H. F. McConomy

Fouling and corrosion occur in all refinery cooling-water systems when treatment is not practiced. Cost of adequate treating methods are in the order of $1 to $5 per day per 1,000 g.p.m. of water circulated and can be justified.

The Refiner's Notebook 116

The Foreman's Page 117

Questions on Technology 118

Pipelining

New Controller Recorder Gravitometer 78

By Henry A. Brainerd and John J. Piros

This unit makes possible the blending of controls automatically to constant outgoing gravity. It is fast, sensitive, and accurate to ±0.1° API.

First LACT System for Low-Gravity, Viscous Crudes 82

By D. H. Stormont

On The Job . . . Pipelining 123

Part 3 of a three-part series on cooling-system maintenance by Dan Haack, of Mid-Continent Pipe Line Co. Carburetor air cleaners can extend engine life and prevent excessive wear and breakdown. Proper over-all maintenance has allowed a number of engines to approach the 40,000-hour mark without showing signs of needing major overhaul.

Drilling-Production

First LACT System for Low-Gravity, Viscous Crudes 82

By D. H. Stormont

This automatic-custody-transfer system is being operated by Union Oil Co. of California in Yorba Linda field near Los Angeles. One company buys crude directly from another by use of positive-displacement meters, checked out by a gravimetric proving system.

How Humble Plans to Control 15,000-Psi. Well Pressures 96

By C. A. Dunlop and T. V. Miller

Wells drilled below 12,000 to 14,000 ft. may in some cases have surface pressure exceeding 10,000 psi. There will be a sharp increase in the number of wells going that deep and deeper. And for these wells, high-pressure equipment is a must.

Torque Requirements for Rotary Shouldered Connections 108

By A. P. Farr

Application of proper makeup torque in all drilling operations may be easily justified. The 58,206 wells drilled in the United States in 1956 probably required 30 to 40 million buckup operations. Improper tonging of these connections resulted in trouble ranging from a slightly damaged connection to loss of a drill string and even loss of a hole.

Wire-Line Tester Tackles Hard Pay Zones . . 120

By Norman S. Morrisey

Originally designed for soft formations, this tool is working satisfactorily in medium and hard formations of the Mid-Continent.

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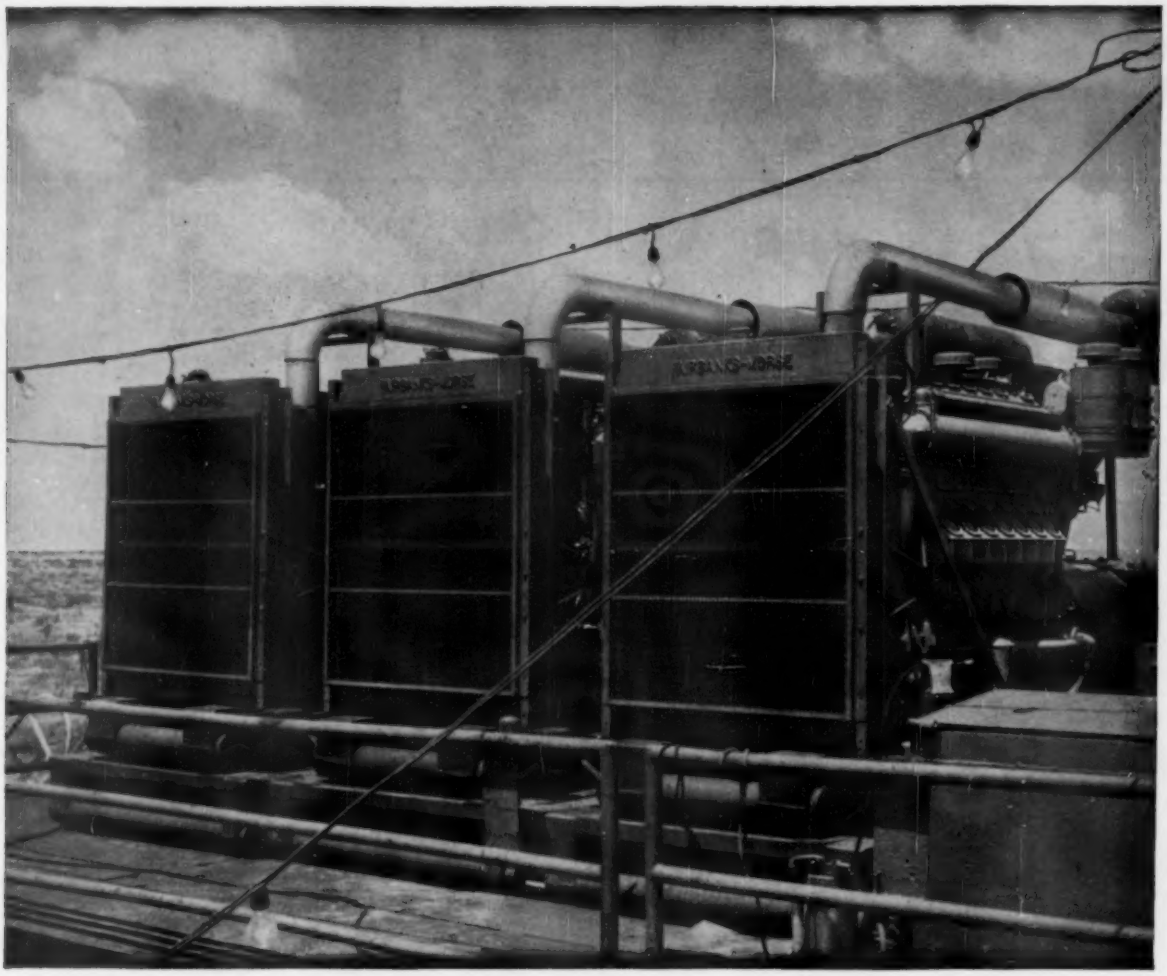

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BY W. E. BETTONEY

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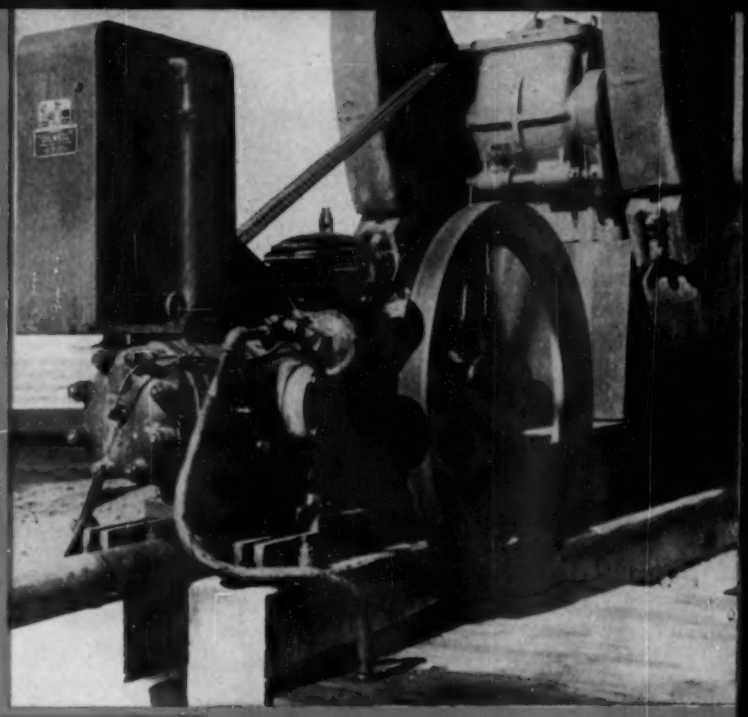

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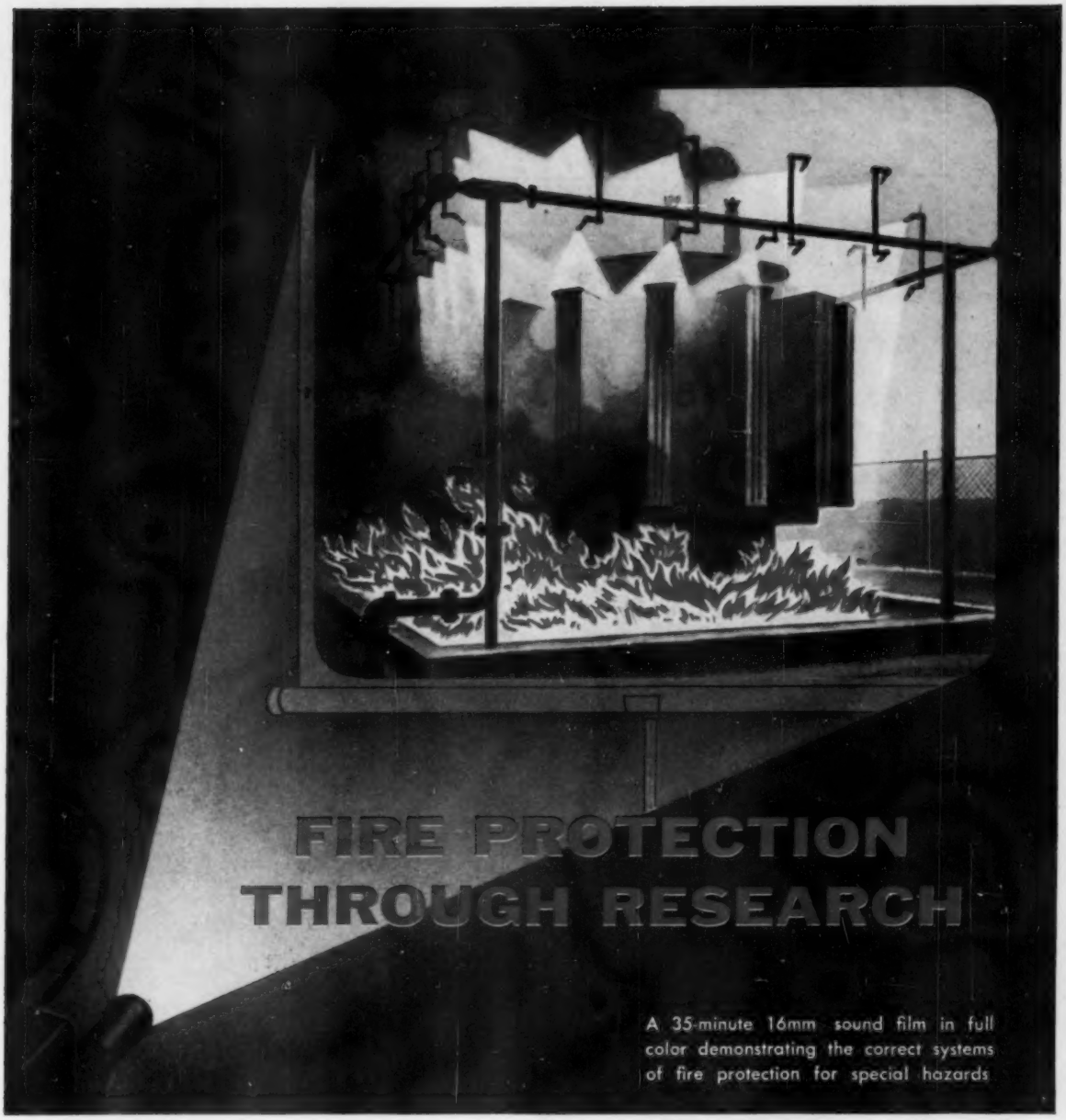
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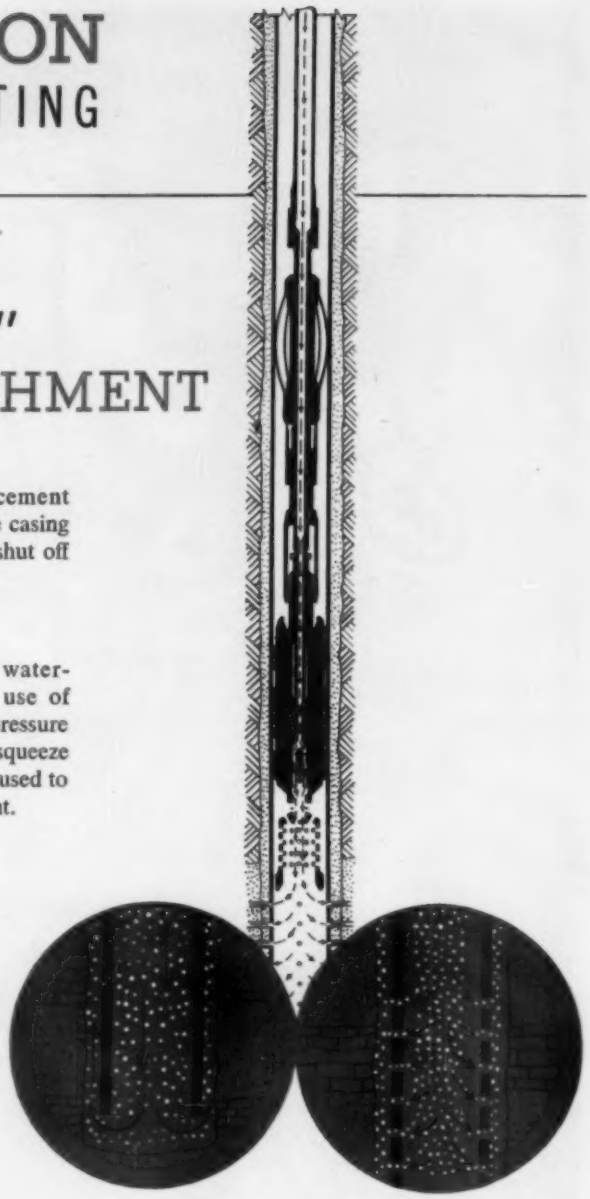

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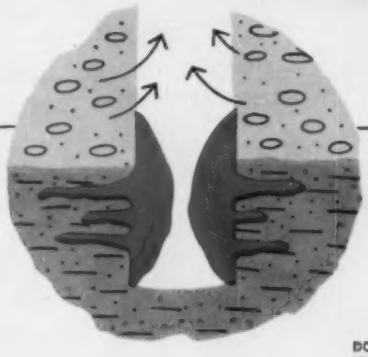

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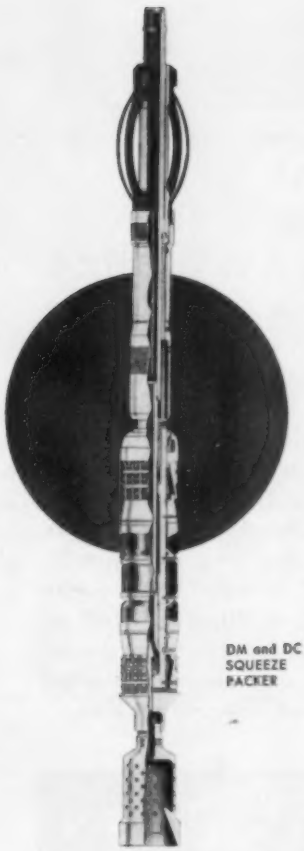

DM and DC
SQUEEZE
PACKER

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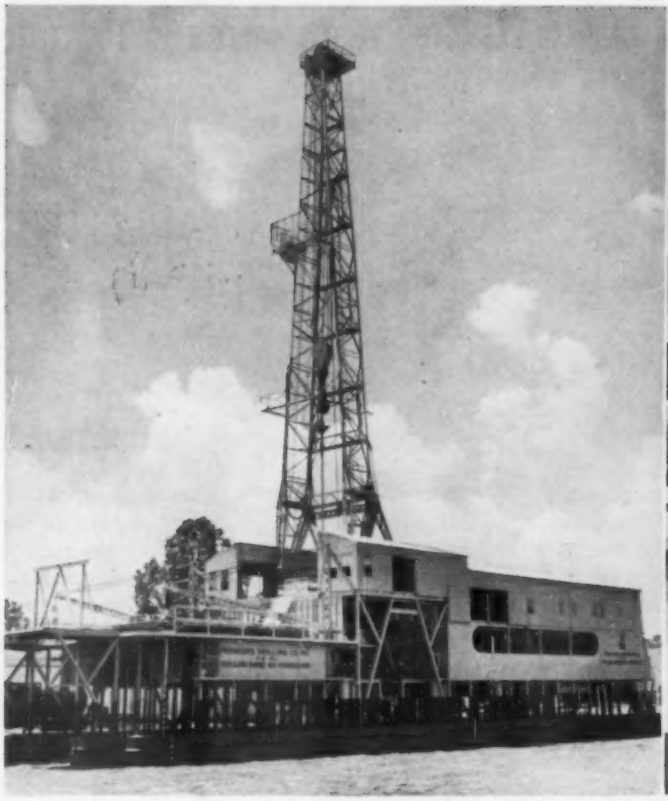
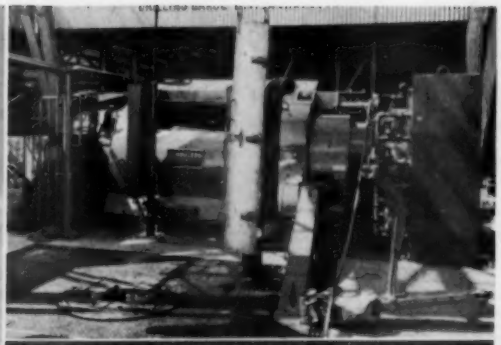
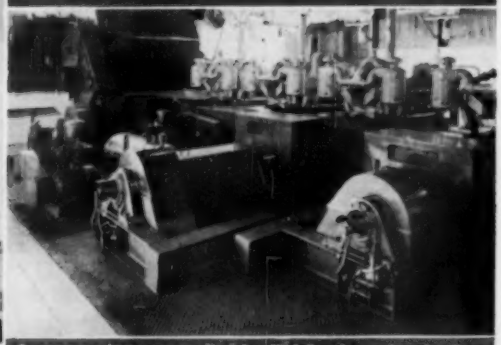
CEMENTING SERVICES

284 SERVICE CENTERS—JUST MINUTES AWAY FROM ANY RIG





On the Producers Drilling Company barge, shown above, is the U-1220 Unit Rig Drawworks and the new 5-27½-A Unit Rig Rotary Table.



Among equipment supplied by Mid-Continent for the Producers Drilling Company barge is the LS-1420 Unit Rig Compound, shown above.

ON THE DRILLING BARGE W. F. YOUNGBLOOD

Another U-1220 UNIT RIG DRAWWORKS FOR HEAVY CONTINUOUS SERVICE

Unit Rig has become known for advanced engineering and as a profitable investment in drilling equipment. Unit Rig equipment is designed for heavy continuous service with a minimum of downtime and repair expense. Leading contractors specify Unit Rig. Producers Drilling Company recently contracted with Mid-Continent Supply Company to furnish a turnkey drilling barge for operation on the Louisiana Gulf Coast. Equipped with a U-1220 Unit Rig Drawworks and LS-1420 Unit Rig compound, this rig meets all requirements of present day deep drilling in the 1,200 to 2,000 horsepower range. The U-1220 drawworks, with mechanical or electric power, already drilling many offshore locations, is applicable for barge or platform drilling as well as land locations. For information on all Unit Rig drilling equipment, contact your Mid-Continent representative.

EXCLUSIVE EXPORT DISTRIBUTOR

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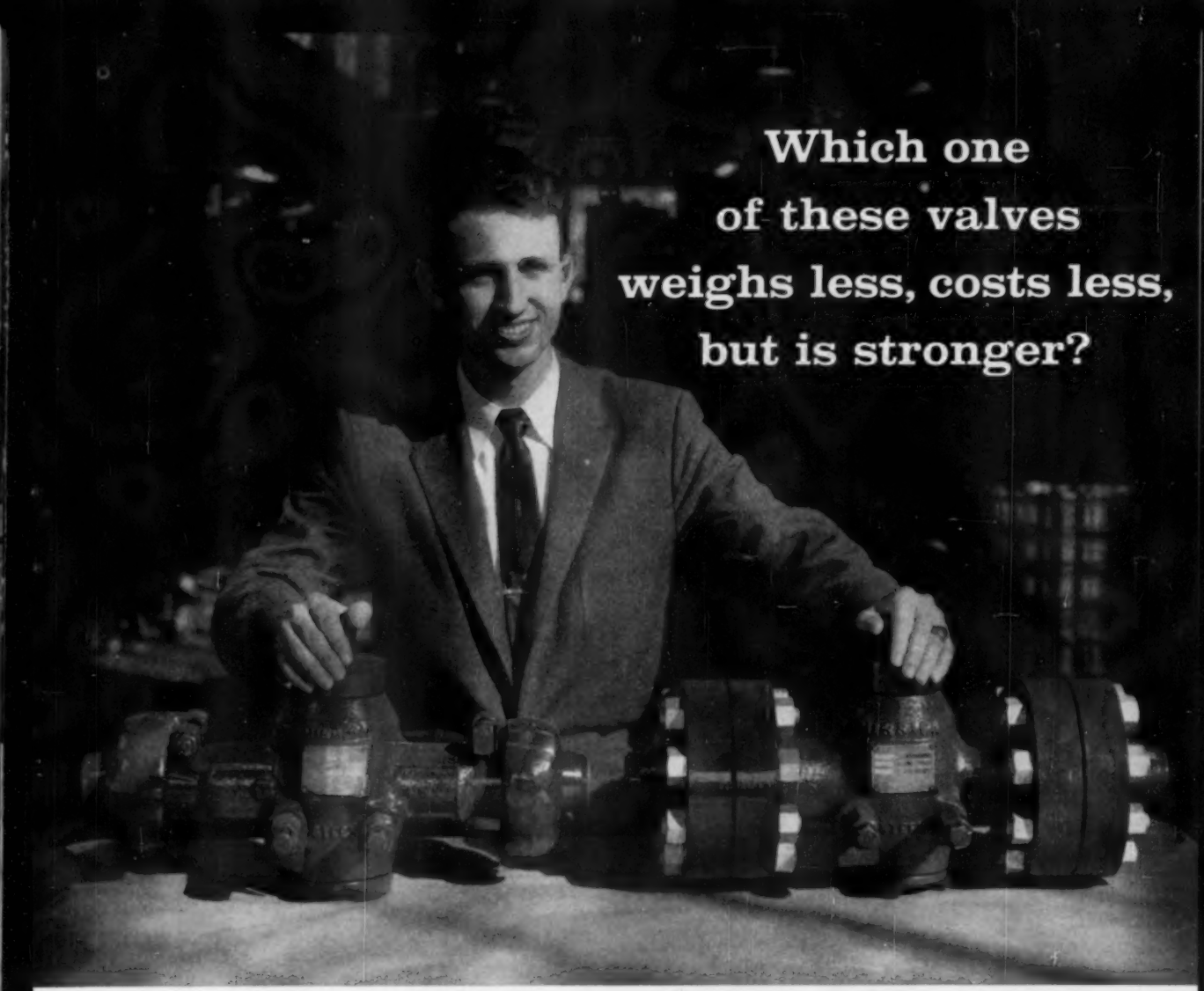
MID-CONTINENT SUPPLY CO.

PESA

THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY



Which one of these valves weighs less, costs less, but is stronger?

Both of these valves are of the same make, model, size, and pressure rating. One is equipped with 2", 6000 lbs. test, Unibolt Couplings, the other with 2", Series 900 flanges. The Unibolt-equipped valve weighs 102 lbs. less, costs about 10% less, and is approximately 28% stronger!

And the advantages don't stop there. Because it weighs less, the Unibolt-equipped valve costs less to ship and is easier to handle, easier to install. (Two bolts and nuts, compared to 16 bolts and 32 nuts.)

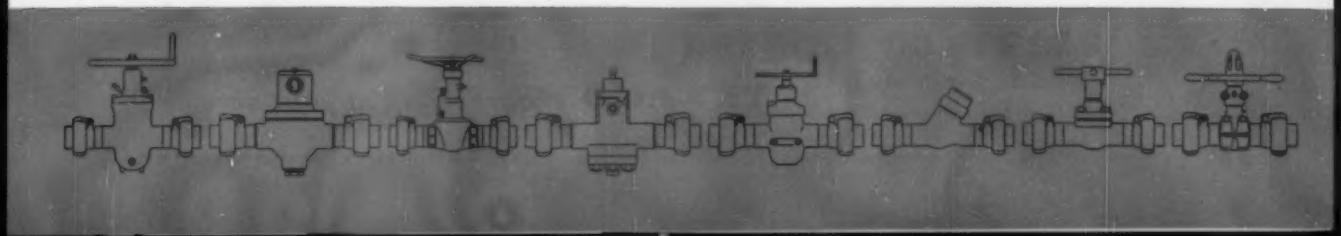
Unibolt Couplings are easy to attach to any valve. Either hub of the Coupling may be butt-welded, socket-welded or screwed to the valve body.

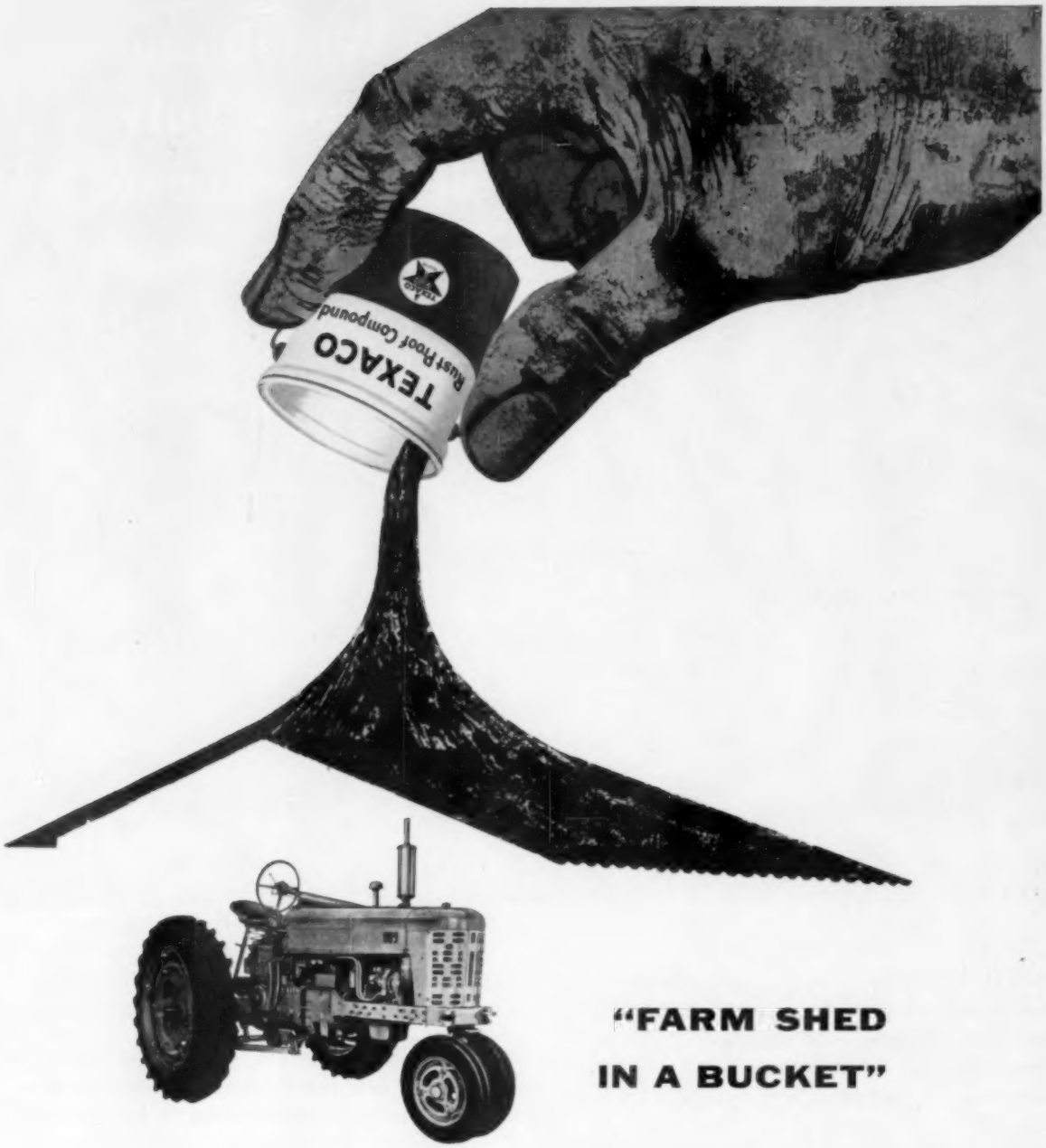
Even if steel were plentiful, Unibolt-equipped valves—as opposed to flanged valves—would be your best buy.

THORNHILL UNIBOLT **CRAVER CO.**

P. O. Box 1184, Houston, Texas

ask your supplier to furnish unibolt-equipped valves





"FARM SHED IN A BUCKET"

America's farmers outproduce the world in food, thanks to the tremendously efficient tractors, cultivating and harvesting equipment developed for them by the farm machinery industry.

Shed space is often lacking in which to store these machines; consequently they often are exposed to the weather for months, when not in use.

Here again, petroleum, on which the farmer depends for power and lubrication, performs another vital service.

Out of a bucket comes a low-cost "farm shed"—a rust-preventive coating that defies the weather and protects his machinery.

Working with industry, Texaco research has developed such coatings to fight rust, the great destroyer . . . another way in which Texaco research has proved itself a vital partner in industrial progress.

TEXACO
THE TEXAS COMPANY

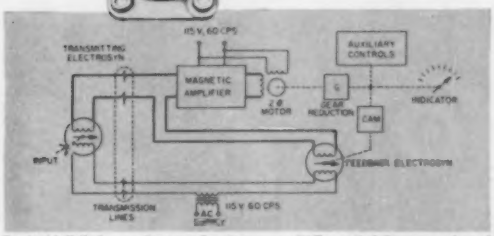
TEXACO ***Progress . . . at your service***

ELECTROSYN AT WORK

Leading pipe line companies are putting ElectroSyn Systems to work measuring and indicating operation pressures and flows and for digital telemetering.

Featuring high reliability, low maintenance and flexibility of application, the ElectroSyn System can withstand a static overload of 300% of rated pressure for a 1% zero shift.

Model 501



Basic Null-Balance System for Pressure, Differential Pressure, Level

Basic system consists of signal transmitter, magnetic servo amplifier, null-balance indicator. (No electron tubes, slide wires or continuously moving parts.)

In measuring pressure the Model 501 transmitter utilizes a twisted bourdon tube as the pressure sensing element. This tube converts the pressure into shaft rotation of the ElectroSyn signal generator, a rotary differential transformer. Output from the ElectroSyn signal generator is an a-c voltage exactly proportional to the measured variable.

Write for Brochure B257

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TEXAS EASTERN TRANSMISSION CORP.
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GULF INTERSTATE GAS CO.
•
SOUTHERN PACIFIC PIPE LINES, INC.
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DETROIT CONTROLS

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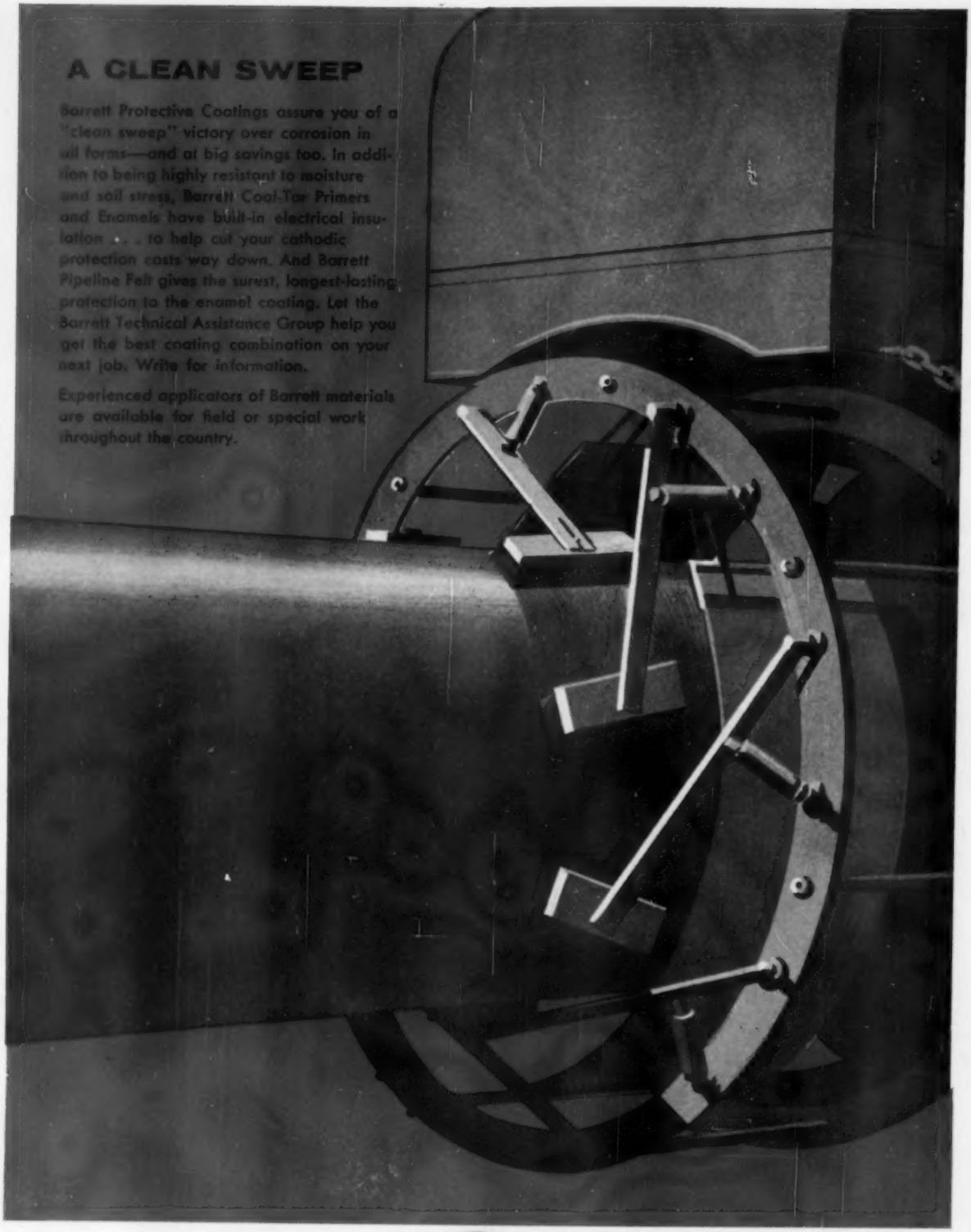

A CLEAN SWEEP

Barrett Protective Coatings assure you of a "clean sweep" victory over corrosion in all forms—and at big savings too. In addition to being highly resistant to moisture and soil stress, Barrett Coal-Tar Primers and Enamels have built-in electrical insulation . . . to help cut your cathodic protection costs way down. And Barrett Pipeline Felt gives the surest, longest-lasting protection to the enamel coating. Let the Barrett Technical Assistance Group help you get the best coating combination on your next job. Write for information.

Experienced applicators of Barrett materials are available for field or special work throughout the country.

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OVER 100 YEARS OF EXPERIENCE

Allied Chemical

How Pipeline Automation helps boost capacity and reduce operating costs

UNION Centralized Transport Control on various oil and gas pipelines has resulted in highly efficient operation and a material increase in pipeline capacity.

Other advantages of UNION C.T.C. are:

1. Less co-mingling of products at the interface because, with UNION C.T.C., fast-acting valves can be used and controlled quickly and accurately.

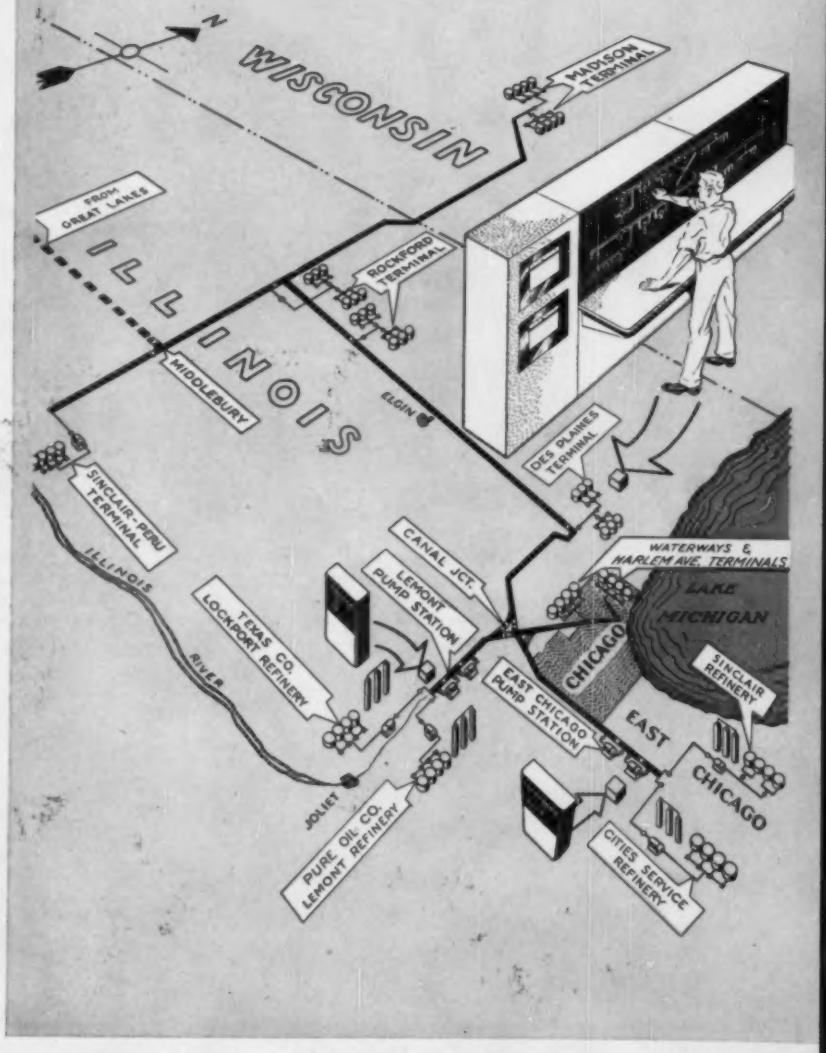
2. No false indications from interface detector because of the accuracy of the message transmitter.

3. Ability to preset movement of products through pipeline eliminates possibility of error.

4. UNION'S C.T.C. System makes it possible to tell when and where trouble is when it occurs.

The installation illustrated was the first of its type and has been in service more than two years. The reliability of the equipment permitted steady operation with little down time and low maintenance.

If you are planning a new pipeline, modernizing an old one, or require control for tank farms or gathering systems, let us show you what UNION Centralized Transport Control can do for you. Write for our latest Bulletin No. 1052.



Over-all plan of Badger Pipeline System. The Des Plaines dispatcher acts as the supervisor of the products flow. All information needed to control the system is contained on the UNION C.T.C. console.

UNION SWITCH & SIGNAL

DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY

PITTSBURGH 18, PENNSYLVANIA

UDT-1091 Turbotorque® Diesel

6-cyl.—5¼ x 7; 1,091 cu. in. displ.; Eng. Max. hp—300 @ 1500 rpm; Power Unit Int. load hp—250 @ 1500 rpm

UD-1091 6-Cyl. Diesel

5¼ x 7; 1,091 cu. in. displ.; Eng. Max. hp—224 @ 1500 rpm; Power Unit Int. load hp—202 @ 1500 rpm

UD-18A 6-Cyl. Diesel

4⅛ x 6½; 691 cu. in. displ.; Eng. Max hp—150 @ 1600 rpm; Power Unit Int. load hp—125 @ 1600 rpm

UV-549 V-8-Cyl. Carbureted

4⅛ x 4⅝; 549 cu. in. displ.; Eng. Max. hp Gaso.—257 @ 3400 rpm; Power Unit Nat. gas: Net hp—178 @ 2600 rpm; Net Max. Torq., lbs.-ft.—397 @ 1600 rpm

UV-461 V-8-Cyl. Carbureted

4⅛ x 4⅝; 461 cu. in. displ.; Eng. Max. hp Gaso.—226 @ 3600 rpm; Power Unit Nat. gas: Net hp—147 @ 2600 rpm; Net Max. Torq., lbs.-ft.—321 @ 1800 rpm

UV-401 V-8-Cyl. Carbureted

4⅛ x 3¾; 401 cu. in. displ.; Eng. Max. hp Gaso.—206 @ 3600 rpm; Power Unit Nat. gas: Net hp—136 @ 2800 rpm; Net Max. Torq., lbs.-ft.—275 @ 1800 rpm

U-281 4-Cyl. Carbureted

4⅛ x 5½; 281 cu. in. displ.; Power Unit Nat. Gas: Net hp—65.5 @ 1800 rpm; Net Max. Torq., lbs.-ft.—214 @ 900 rpm

U-175 4-Cyl. Carbureted

3⅜ x 4½; 175 cu. in. displ.; Power Unit Nat. Gas: Net hp—48 @ 2000 rpm; Net Max. Torq., lbs.-ft.—130 @ 1300 rpm

U-123 4-Cyl. Carbureted

3⅜ x 4; 123 cu. in. displ.; Power Unit Nat. Gas: Net hp—23.4 @ 2000 rpm; Net Max. Torq., lbs.-ft.—68.5 @ 1350 rpm

UC-60 4-Cyl. Carbureted

2⅜ x 2½; 60 cu. in. displ.; Power Unit Nat. gas: Net hp—13.5 @ 2500 rpm; Net Max. Torq., lbs.-ft.—30.7 @ 1400 rpm

U-1091 6-Cyl. Carbureted

5¾ x 7; 1,091 cu. in. displ.; Eng. Max. hp: Propane—269 @ 1600 rpm; Power Unit Nat. gas: Net hp—232 @ 1600 rpm; Net Max. Torq., lbs.-ft.—860 at 1100 rpm

U-501 6-Cyl. Carbureted

4⅛ x 5¼; 501 cu. in. displ.; Basic Engine Max. hp: Gaso.—212 @ 3000 rpm; Power Unit Nat. gas: Net hp—113.5 @ 2200 rpm; Net Max. Torq., lbs.-ft.—327 @ 1300 rpm

U-450 4-Cyl. Carbureted

4⅛ x 5; 450 cu. in. displ.; Basic Engine Max. hp: Gaso.—182 @ 3000 rpm; Power Unit Nat. gas: Net hp—105 @ 2200 rpm; Net Max. Torq., lbs.-ft.—278 @ 1500 rpm

UD-525 8-Cyl. Diesel

4½ x 5½; 325 cu. in. displ.; Eng. Max. hp—137 @ 2000 rpm; Power Unit Int. load hp—115 @ 1800 rpm

UD-14A 4-Cyl. Diesel

4¾ x 6½; 461 cu. in. displ.; Eng. Max. hp—105 @ 1800 rpm; Power Unit Int. load hp—76 @ 1400 rpm

UD-350 4-Cyl. Diesel

4½ x 5½; 350 cu. in. displ.; Eng. Max. hp—92 @ 2000 rpm; Power Unit Int. load hp—75 @ 1800 rpm

UD-281 4-Cyl. Diesel

4⅛ x 5¼; 281 cu. in. displ.; Eng. Max hp—68 @ 1800 rpm; Power Unit Int. load hp—60 @ 1800 rpm

21 production boosters that give you a full measure of dependable power!

Here is the complete expanded line of 21 International power units that boost your production, not your power costs. Whether diesel or carbureted—V-8, 6 or 4-cylinders—each gives you a full measure of dependable power on your drill, pump, or service rigs.

All 21 Internationals shown here are available in varying stages from an engine to a complete power unit.

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Seven International diesels, rated from 60 to 250 net hp (300 max. hp), are outstanding for easy, all-weather starting and low consumption of No. 2 diesel fuel. Like the carbureted models, these rugged 4-cycle units are fully sealed against life-robbing dirt and dust.

See your International Power Unit Distributor or Dealer soon. He will show you how International oil field engines are tailored for dependability and lower power costs. You'll like the way he can be counted on to service what he sells, too.

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A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.

U-372 6-Cyl. Carbureted

4⅞ x 4½; 372 cu. in. displ.; Basic Engine Max. hp: Gaso.—165 @ 3200 rpm; Power Unit Nat. gas: Net hp—87.5 @ 2200 rpm; Net Max. Torq., lbs.-ft.—228 @ 1450 rpm

U-308 6-Cyl. Carbureted

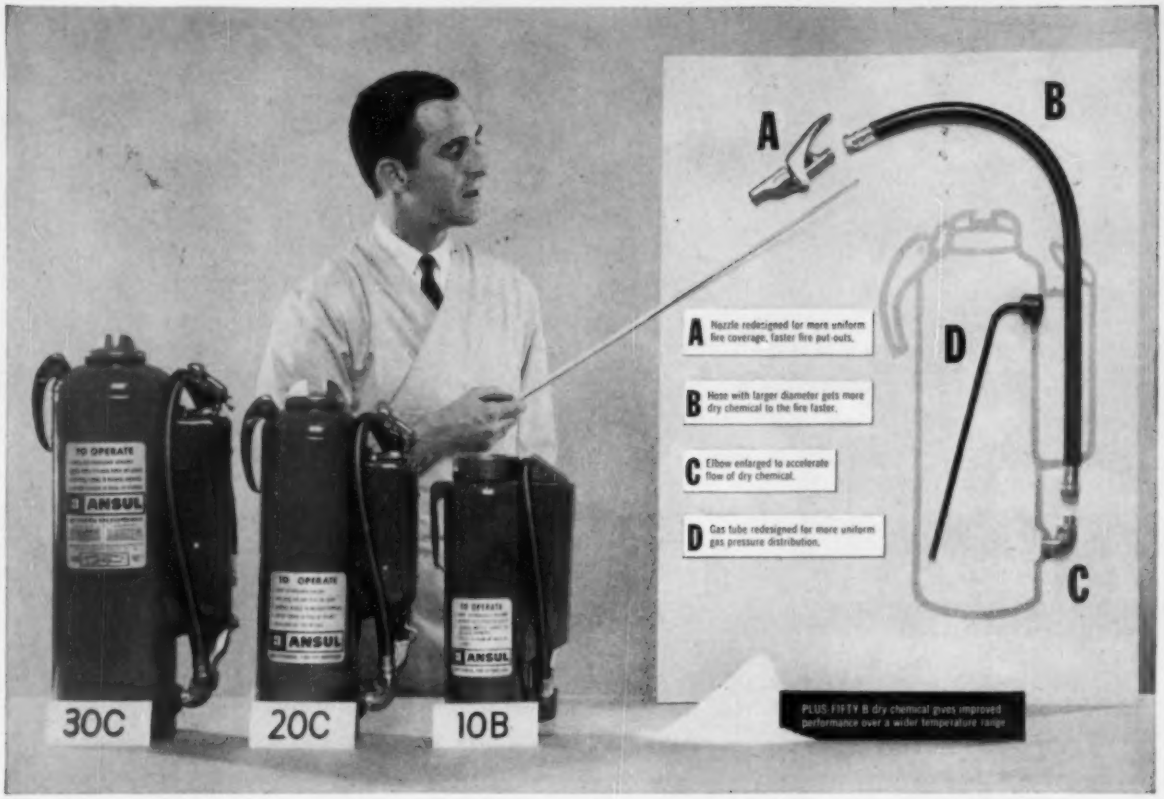
3⅞ x 4½; 308 cu. in. displ.; Basic Engine Max. hp: Gaso.—154 @ 3600 rpm; Power Unit Nat. gas: Net hp—78.5 @ 2400 rpm; Net Max. Torq., lbs.-ft.—202 @ 1500 rpm

U-264-6 6-Cyl. Carbureted

3⅞ x 4½; 264 cu. in. displ.; Basic Engine Max. hp: Gaso.—153 @ 3700 rpm; Power Unit Nat. gas: Net hp—68.5 @ 2400 rpm; Net Max. Torq., lbs.-ft.—172 @ 1350 rpm

U-220 6-Cyl. Carbureted

3¾ x 3½; 220 cu. in. displ.; Basic Engine Max. hp: Gaso.—112 @ 3700 rpm; Power Unit Nat. gas: Net hp—58 @ 2400 rpm; Net Max. Torq., lbs.-ft.—146.5 @ 1400 rpm


A
B
D
C
A Nozzle redesigned for more uniform fire coverage, faster fire put-outs.
B Hose with larger diameter gets more dry chemical to the fire faster.
C Elbow enlarged to accelerate flow of dry chemical.
D Gas tube redesigned for more uniform gas pressure distribution.
PLUS FIFTY B dry chemical gives improved performance over a wider temperature range
30C
20C
10B

Important design improvements in these Ansul Extinguishers give you more fire fighting power at no increase in price. Three years of research and more than 2000 fire tests turned up some significant new information on dry chemical extinguishment. Ansul engineers were able to design these findings into three new extinguisher models, the 10B, 20C and 30C. Result, greatly increased fire fighting power. All Ansul equipment is backed by a five-year warranty. This is the best way we know to say Ansul fire extinguishers are the finest of their kind made anywhere.

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The Ansul Chemical Co., Marinette, Wisconsin

WESTERN UNION

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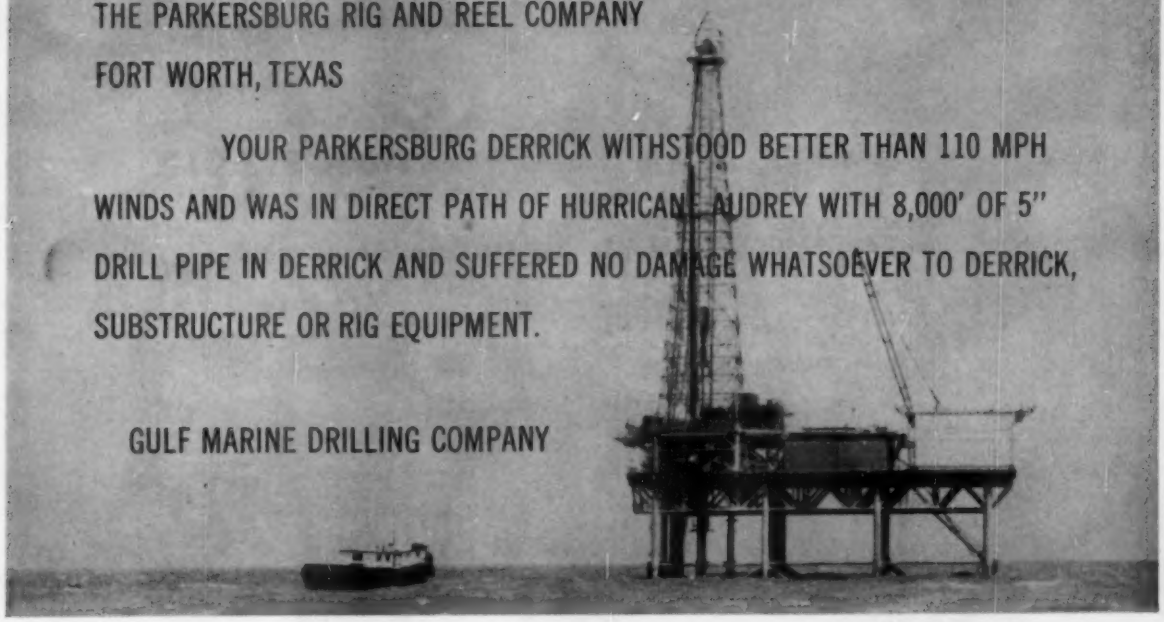
FORT WORTH, TEXAS

YOUR PARKERSBURG DERRICK WITHSTOOD BETTER THAN 110 MPH WINDS AND WAS IN DIRECT PATH OF HURRICANE AUDREY WITH 8,000' OF 5" DRILL PIPE IN DERRICK AND SUFFERED NO DAMAGE WHATSOEVER TO DERRICK, SUBSTRUCTURE OR RIG EQUIPMENT.

GULF MARINE DRILLING COMPANY



Hurricane Audrey vs. Parkersburg Galemaster

Hurricane Audrey found out what drilling rig owners have known for years — a Parkersburg Galemaster derrick is designed and built right for strength and durability. The most severe hurricane to rake the Gulf Coast since drilling rigs moved off-shore was unable to knock over the Galemaster derrick on the Gulf Marine Drilling Co. platform 20 miles off Cameron, Louisiana. Some derricks tumbled under the force of the wind but the Galemaster rode out the storm.

Get this added protection that only Parkersburg Galemaster derricks provide. There is a Galemaster in either a single well, two-well, or six-well design to suit your requirements. For gale insurance, buy a Parkersburg Galemaster derrick.

At Parkersburg, quality and service have gone hand-in-hand for 60 years!

The **PARKERSBURG** RIG & REEL COMPANY

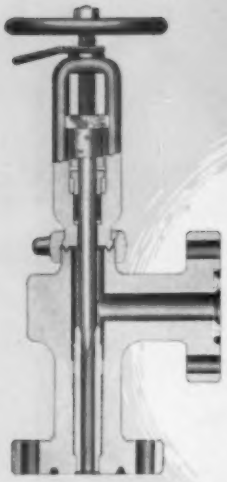
DIVISION OF PARKERSBURG – ÆTNA CORPORATION

DRILLING AND SPECIALTIES DIVISION OFFICES:

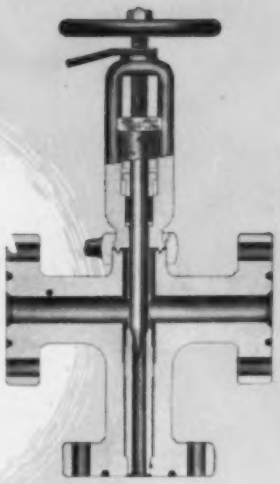
P. O. BOX 1160 • PARKERSBURG, WEST VIRGINIA

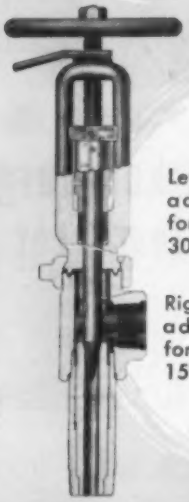
O·C·T offers a complete

ADJUSTABLE CHOKES



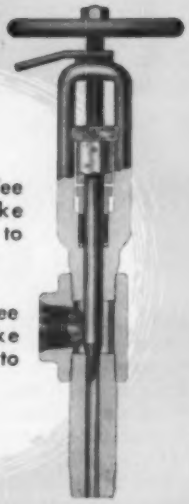
Type "N-2" Tee (Left) and Type "N-2" Cross (Right) adjustable chokes are suitable for pressures in excess of 3000 psi.

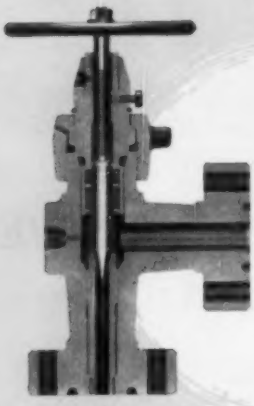




Left: Type "N" Tee adjustable choke for pressures up to 3000 psi.

Right: Type "O" Tee adjustable choke for pressures up to 1500 psi.





Type "JW" Tee adjustable choke for pressures up to 10,000 psi.

ALL SIZES

0.0273" to 2¼"

ALL PRESSURE RATINGS

1,500 psi to 30,000 psi

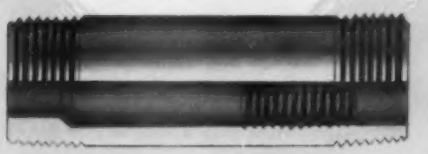
line of chokes...and every one is the best of its kind!

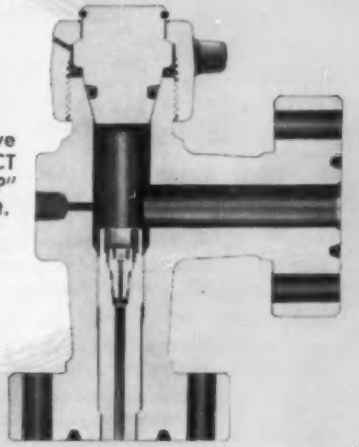
OCT Type "FC-25"
Positive flow beam.

POSITIVE CHOKES

OCT makes a complete line of cross and tee choke fittings in all popular sizes and all pressure ratings, as well as a complete line of cage nipples, flow beans, and proration inserts. Most choke fittings will accommodate either positive flow beans or adjustable choke assemblies. This interchangeability reduces the inventory of parts required to service wells in a given field.

OCT Type "FC-140"
Cage nipple and
flow bean.





Type PC Positive
choke with OCT
Type "FC-142-P"
Proration insert.

OCT Type
"FC-142-P"
Proration
insert.

ALL parts of OCT Chokes are carefully made of materials best suited to the requirements of the well. Precision machining assures maximum safety as well as interchangeability of parts.

ALL MATERIALS

OCT Chokes are made in a complete range of materials from special analysis steel for general duty to tungsten carbide, monel or stainless steel for "problem" applications.

O·C·T

OIL CENTER TOOL CO.

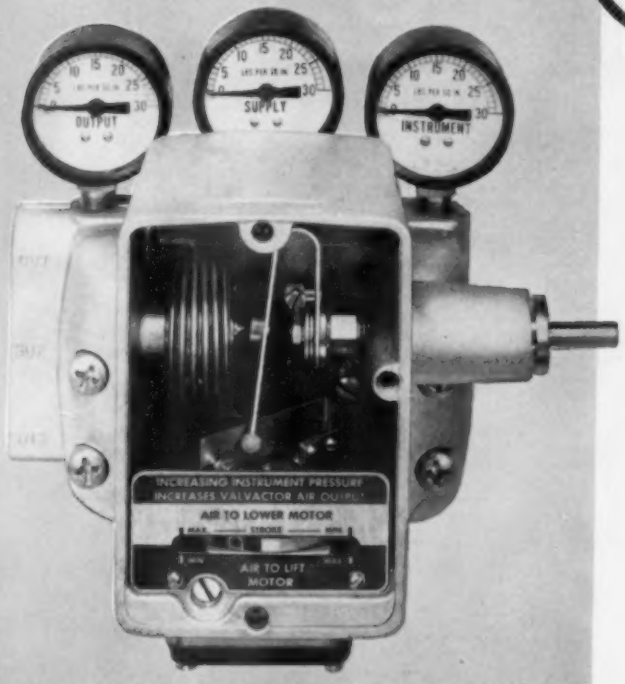
A Subsidiary of Food Machinery and Chemical Corporation

Export Representatives: South America—East West Oiltools, C. A., Del Lago Hotel, Maracaibo, Venezuela. Address Export Inquiries for All Other Countries to P. O. Box 3091, Houston, Texas.

NEW!

MOST UNIVERSALLY ADAPTABLE VALVE POSITIONER ON THE MARKET!

...the Foxboro Type C VERNIER VALVACTOR*



The Type C Valvactor's distinctive motion-balance principle of stem positioning eliminates loading effects of heavy fixed-stroke actuating springs. Note compactness — the simplest mechanical design of any valve positioner.

*Trademark of a precision valve positioner made by The Foxboro Co.

Unique Flexibility Easily reversible in seconds. Sequencing by two simple adjustments.

Super Response Full air-pressure output to diaphragm motor on signal air-pressure change as small as ½ of 1% of signal span.

Extra Speed New, high capacity relay provides high speed positioning action.

Positive Positioning Direct, motion-balance feed-back assures instantaneous, pin-point positioning.

Now there's a positive-action, super-precision valve positioner that you can easily adapt to *any* diaphragm motor application — without exchange of parts! It's the Foxboro Type C Vernier Valvactor with unique motion-feedback.

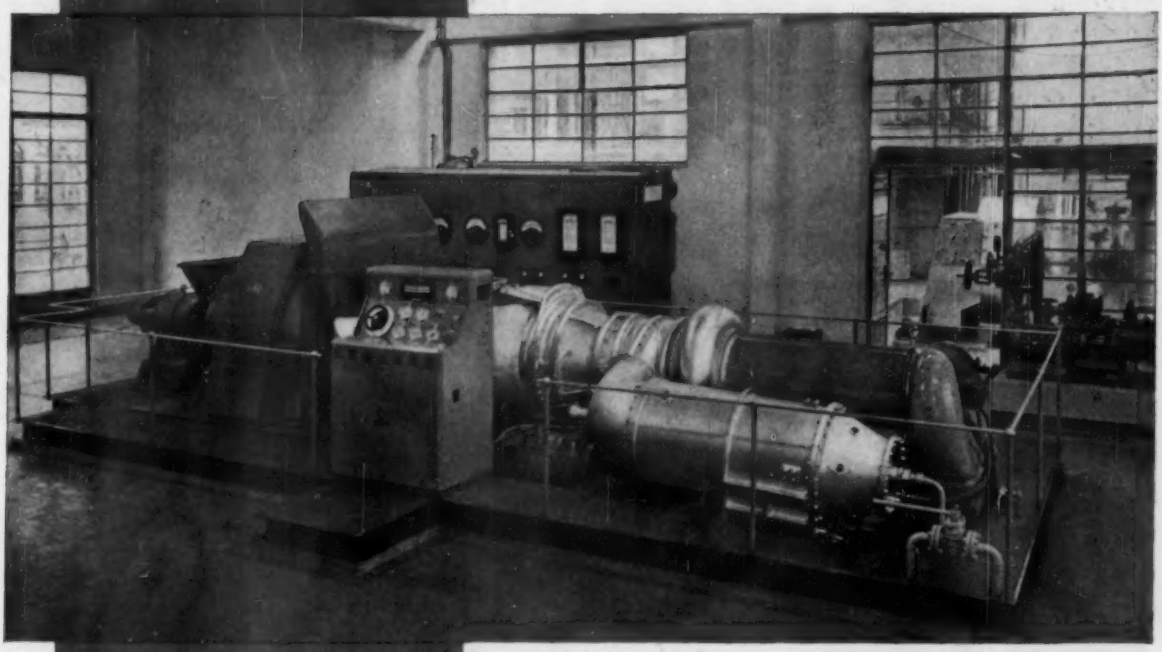
The Type C Valvactor has a master setting disc which provides easy change of action as required by the control system, as well as easy reversal of Valvactor action for air-to-open or air-to-close control valves. Adjusting for limited stem travel is equally simple ... sequencing of several valves is a cinch!

The Valvactor is the ideal solution to such problems as stem friction, plug friction, valve motor and transmission line lag, and extreme process line pressure changes. And it requires practically no maintenance! Available with 3-gauge and by-pass manifold, or plain manifold. Write for full details.

The Foxboro Company, 6012 Norfolk St., Foxboro, Mass., U.S.A.

FOXBORO
REG U.S PAT OFF
VALVE POSITIONERS

NOW for the first time...



The Mark TA gas turbine generating power and process steam in a refining application.

all power services in one package

In applications where multiple power services are required such as power generation, compressing, pumping, space heating, refrigeration, air conditioning, drying, or evaporating, the Clark Mark TA gas turbine is the economical choice.

Exhaust gases from this 1,150 bhp. gas turbine contain up to 10,000,000 BTU/H of recoverable energy at a temperature of 870°F. While these gases contain some products of combustion, 90% of the original oxygen content is still present.

The exhaust gases are useful where preheated air is desirable for combustion or supercharging purposes, for drying applications, catalyst regeneration, feedwater heating, evaporation of sea water, etc. These gases can also be used in air to air heat exchangers for space heating or to generate up to 9,500 pounds of low pressure steam per hour for process use. If even higher temperature gases are required, the Mark TA can be used solely as a power gas generator to provide gases of 1020°F at 20-22 psia. and a mass flow of 20 pounds per second.

For large stores, auditoriums, hotels, hospitals and office buildings, the Mark TA can provide approximately 1800 tons of air conditioning or refrigeration in the summer using the absorption cycle and also provide steam for heating in the winter. In all applications except power gas generating, this modern gas turbine also supplies 1,150 bhp. of rotative energy for pump, generator, or compressor drive.

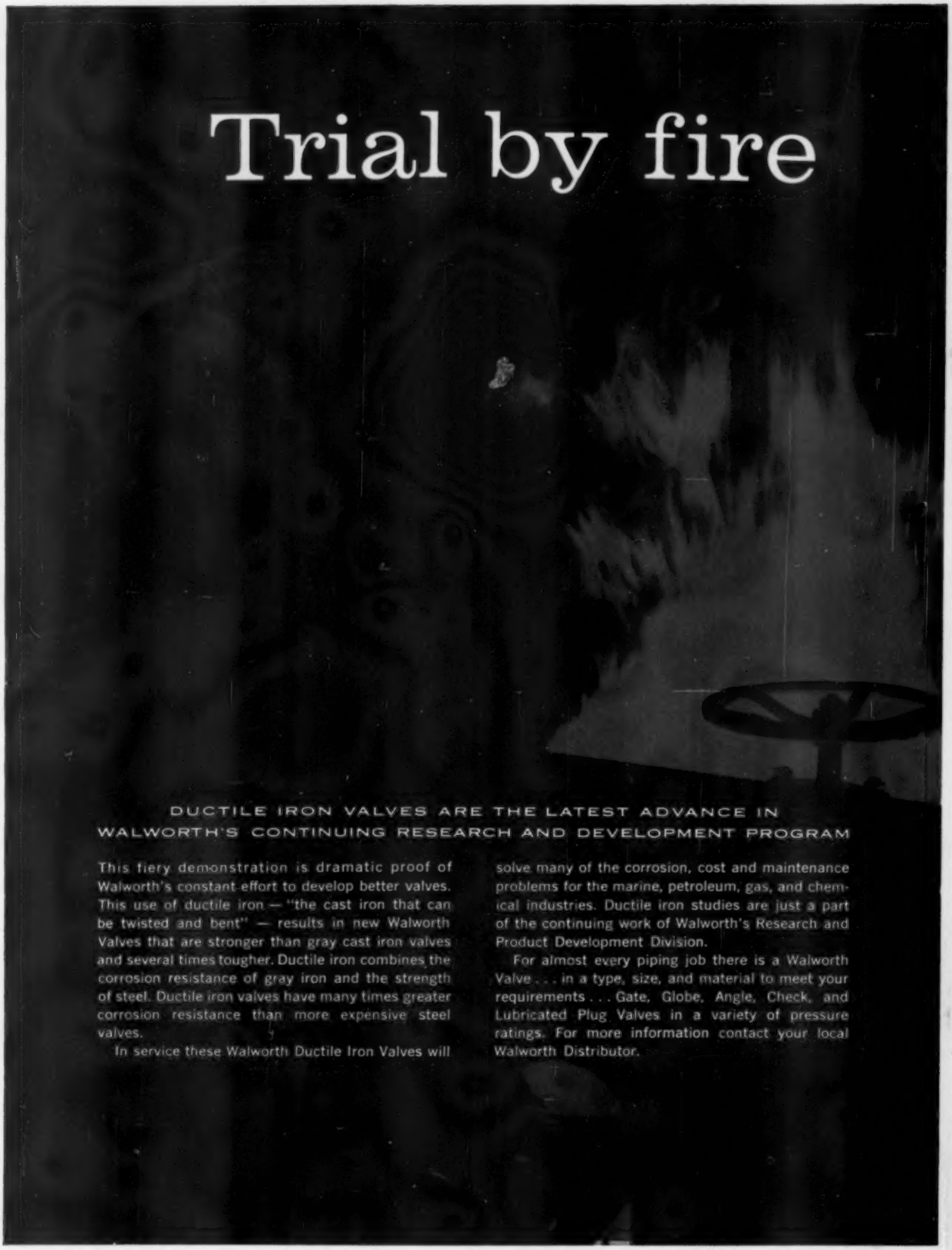
Clark engineers stand ready to assist you in applying the Mark TA gas turbine to your application. Larger units with ratings of 9,500 bhp. are also available from Clark. Write for Bulletin No. 142.

CLARK BROS. CO., OLEAN, N.Y.
One of the Dresser Industries
Offices in Principal Cities Throughout the World

Clark Bros. Co. is licensed to manufacture the Mark TA gas turbine in this country by Ruston-Hornsby, Ltd., Lincoln, England.

CLARK

Trial by fire



DUCTILE IRON VALVES ARE THE LATEST ADVANCE IN
WALWORTH'S CONTINUING RESEARCH AND DEVELOPMENT PROGRAM

This fiery demonstration is dramatic proof of Walworth's constant effort to develop better valves. This use of ductile iron — "the cast iron that can be twisted and bent" — results in new Walworth Valves that are stronger than gray cast iron valves and several times tougher. Ductile iron combines the corrosion resistance of gray iron and the strength of steel. Ductile iron valves have many times greater corrosion resistance than more expensive steel valves.

In service these Walworth Ductile Iron Valves will solve many of the corrosion, cost and maintenance problems for the marine, petroleum, gas, and chemical industries. Ductile iron studies are just a part of the continuing work of Walworth's Research and Product Development Division.

For almost every piping job there is a Walworth Valve . . . in a type, size, and material to meet your requirements . . . Gate, Globe, Angle, Check, and Lubricated Plug Valves in a variety of pressure ratings. For more information contact your local Walworth Distributor.

WALWORTH SUBSIDIARIES: ALLOY STEEL PRODUCTS CO. • CONOFLOW CORPORATION • GROVE VALVE AND REGULATOR CO.

WALWORTH

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

In the first stage of thermal shock test, oil fire and gas flame heat a 6-inch Walworth Gate Valve constructed of ductile iron to a red hot temperature of 1350°F.

Now the Walworth Valve is quickly chilled with streams of water. A cast iron valve could shatter under such a drastic and rapid change in temperature.

Slightly scorched, the valve keeps its shape and dimensions despite the ordeal and is completely operable. The test proved that, under these conditions, Walworth ductile iron valves have a thermal shock resistance equal to that of more expensive steel valves.

NEW WALWORTH PRODUCTS AND DEVELOPMENTS

FORGED STEEL WEDGE GATE VALVES

. . . for water, steam, gas, and air service to 850°F. Oil or oil vapor to 1000°F. OS & Y types. Screwed or socket welding ends. Bolted or union bonnets. Sizes from ¼ to 2 inches.

FABRICATED PULP STOCK VALVES

. . . for lines carrying pulp stock in varying concentrations, slurries, and other fibrous materials in suspension. All-welded stainless steel construction. Corrosion resistant. Sizes from 3 to 30 inches.

PVC VALVES AND FITTINGS

. . . made of rigid, unplasticized polyvinyl chloride. Highly resistant to chemical attack. Non-toxic, Non-aging. Extremely low flammability. Sizes from ½ to 4 inches.

SOUTHWEST FABRICATING & WELDING CO., INC. • M&H VALVE AND FITTINGS CO. • WALWORTH COMPANY OF CANADA, LTD.

Why your busiest superintendent just got a busy signal

In the fast-moving petroleum industry, delays in handling phone calls can be mighty costly.

A P-A-X business telephone system is the answer. P-A-X is your own private dial telephone system for calls within your organization. It is fully automatic . . . entirely independent of your rented switchboard. Leaves your present board free to handle outside calls swiftly and efficiently.

Good things happen when you install P-A-X. Time is saved. Employees dial their calls, right from their jobs—instead of walking to reach a phone. Executives get action—instead of "Sorry, no lines." Customers phoning in get you the *first* time they call.

There are no toll or rental charges for P-A-X. You *own* the system. And it soon pays for itself.

We'll be glad to send you an interesting case-history brochure that tells how P-A-X is saving important money daily for a major oil company. Write today for your copy. Automatic Electric Sales Corporation, Northlake, Illinois.

P-A-X telephone communications for the Petroleum Industry

AUTOMATIC ELECTRIC

A member of the General Telephone System
One of America's great communications systems

GENERAL SYSTEM

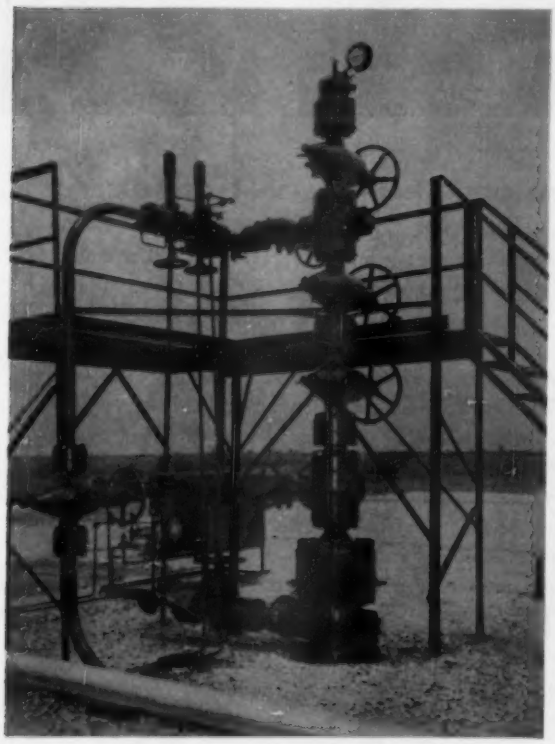
EASY OPERATION UP TO 15,000 LBS. PRESSURE

W-K-M *Balanced Stem* VALVE

The revolutionary W-K-M® Balanced Stem Gate Valve is the easiest to operate high-pressure valve ever made. Even under its full rated load of 15,000 lbs. the valve opens and closes freely.

The pressure in the valve body causes the balancing stem attached to the bottom of the gate to exert a force equal to, and in the opposite direction from the force exerted on the operating stem. The only force to be overcome is the gate drag which depends upon the pressure differential across the gate.

The W-K-M Balanced Stem Valve incorporates the same parallel expanding gate design as all W-K-M Gate Valves, thus providing a tight seal upstream and downstream plus all of the other advantages inherent in this outstanding design.



OTHER IMPORTANT W-K-M VALVE FEATURES

- Can be fully repaired while on the tree.
- Bronze and steel stem threads located outside body, easily lubricated
- High Pressure Packing
- Superfinished Stems
- Two Ball Thrust Bearings

When you need to control high pressures you will find you can do it best with W-K-M Balanced Stem Valves. Write Dept. A-1202 for Bulletin WP 1157 for specifications and engineering data on the Balanced Stem Valve and for information on W-K-M Through-Conduit Gate Valves for all field services ask for Catalog 200.

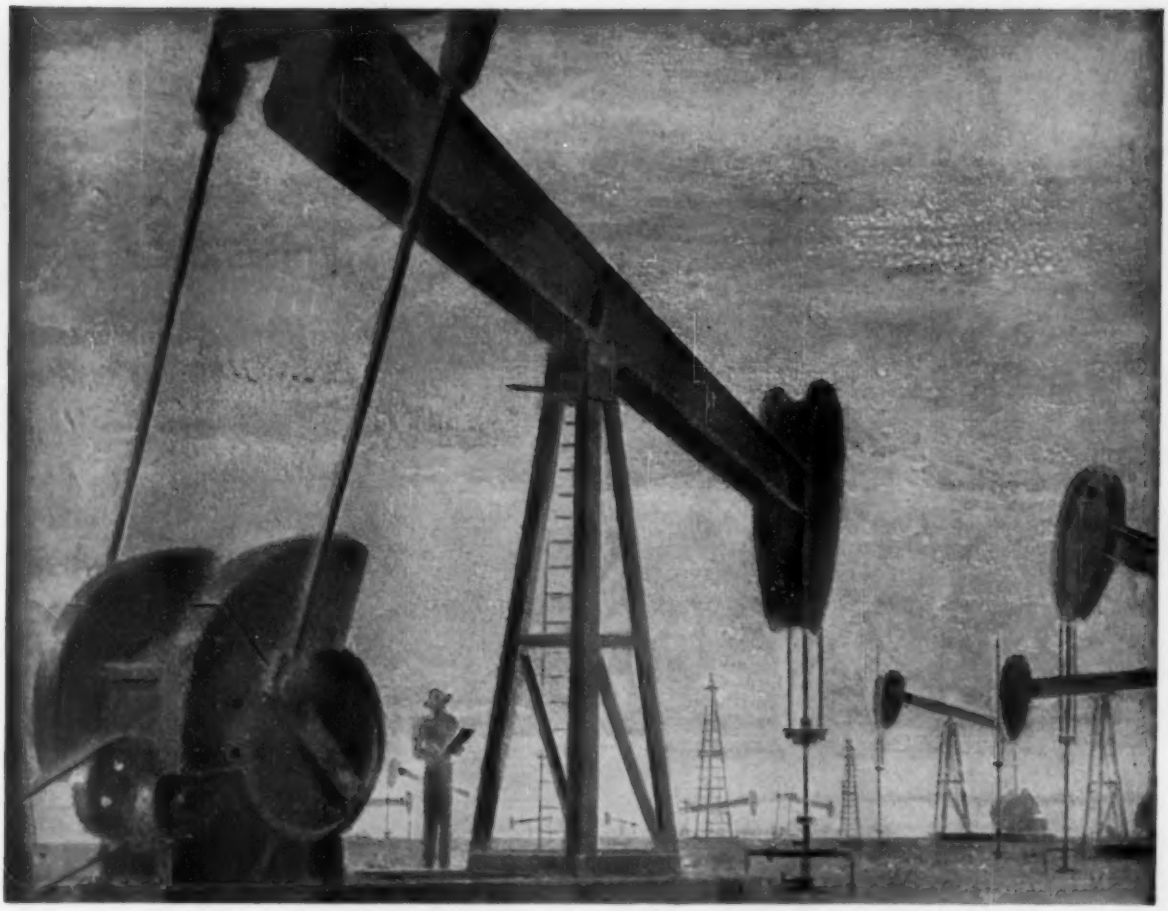
W-K-M

DIVISION OF ACF INDUSTRIES INCORPORATED

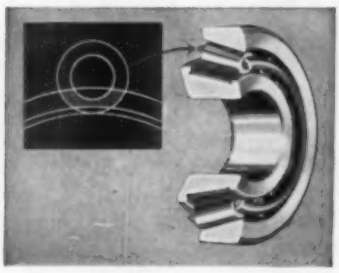
PLANT: MISSOURI CITY, TEXAS
MAILING ADDRESS: P. O. BOX 2117, HOUSTON, TEXAS

MANUFACTURERS OF W-K-M GATE VALVES ACF LUBRICATED PLUG VALVES
KEY-KAST ALLOY STEEL PIPING FITTINGS KEY RETURN BENDS AND FITTINGS
5720

W-K-M is a registered trademark of ACF Industries, Inc.



Built to stand up . . . under 'round-the-clock pressure!



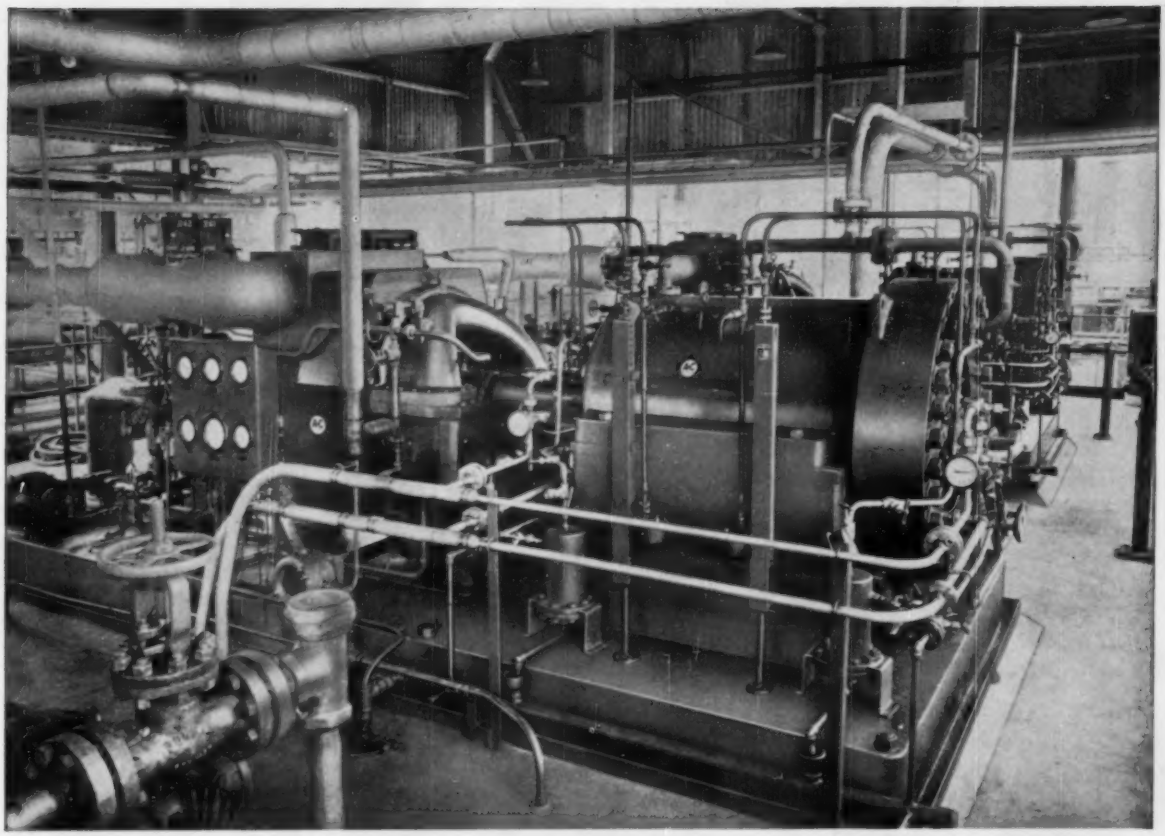
HIGHER FLANGE IMPROVES ROLLER ALIGNMENT

As shown by the gray area above, the higher flange provides a large two-zone contact area for the roller heads. This greatly reduces wear—practically eliminates "end play". Larger oil groove provides positive lubrication.

The flow of America's vital oil can't be regulated by a time clock! These bobbing pumps work around the clock, around the year—with virtually no attention whatever! Dependable Bower Roller Bearings are more than proving their ability to stand this back-breaking pace—doing it with a minimum of maintenance cost and down-time. That's because important Bower Spher-O-Honed design features, like the one shown at left, have reduced bearing failure to a rarity. Whatever test *you* put them to—tractors, machine tools, jet engines—you'll find that Bower Spher-O-Honed Bearings will last longer and operate more efficiently. Let a Bower engineer show you the many advanced design features and superior quality of the complete Bower line. There are tapered, straight and journal roller bearings for every field of transportation and industry.

BOWER ROLLER BEARING DIVISION
FEDERAL-MOGUL-BOWER BEARINGS, INC. • DETROIT 14, MICHIGAN

BOWER ROLLER BEARINGS



Engineered and constructed by The M. W. Kellogg Company.

Gulf Refinery Uses Allis-Chalmers Compressors for Hydrogen Recycling

Two high pressure compressors of the latest Allis-Chalmers barrel-type design are in use at the Gulf Oil Corporation Plant at Port Arthur, Texas.

These units are used in a desulphurization process, in the refining of fuel oil. They are typical of Allis-Chalmers units chosen for upgrading processes.

Allis-Chalmers builds centrifugal, axial, and rotary sliding-vane type compressors for all refinery applications. Contact your nearby A-C office for information about your requirements, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

A-5421

ALLIS-CHALMERS

KING SIZE

This giant 37 ton Cat Poly Reactor is one of 4 units shipped to a large petroleum refinery in the State of Washington. It is 4'-3½" in diameter by 32'-0" long and has a 1 3/16" thick shell. Each of its 8" thick heads is attached to the shell channel with 28 special alloy stud bolts 2¾" diameter by 15¼" long having nuts 4¼" across the flats. Into the 5¾" thick tube sheets 190 tubes, 2½" O. D., No. 5 gauge and 30'-0" long, are rolled and seal welded. Designed for 1,230 lbs. pressure on the tube side, the reactor was completely X-rayed and stress relieved.

Vogt, a leading builder of shell and tube reactors for poly plants, has the competently skilled personnel and modern mechanical facilities with which to provide heat transfer equipment for the most exacting services in petroleum refineries, chemical plants, and related industries.

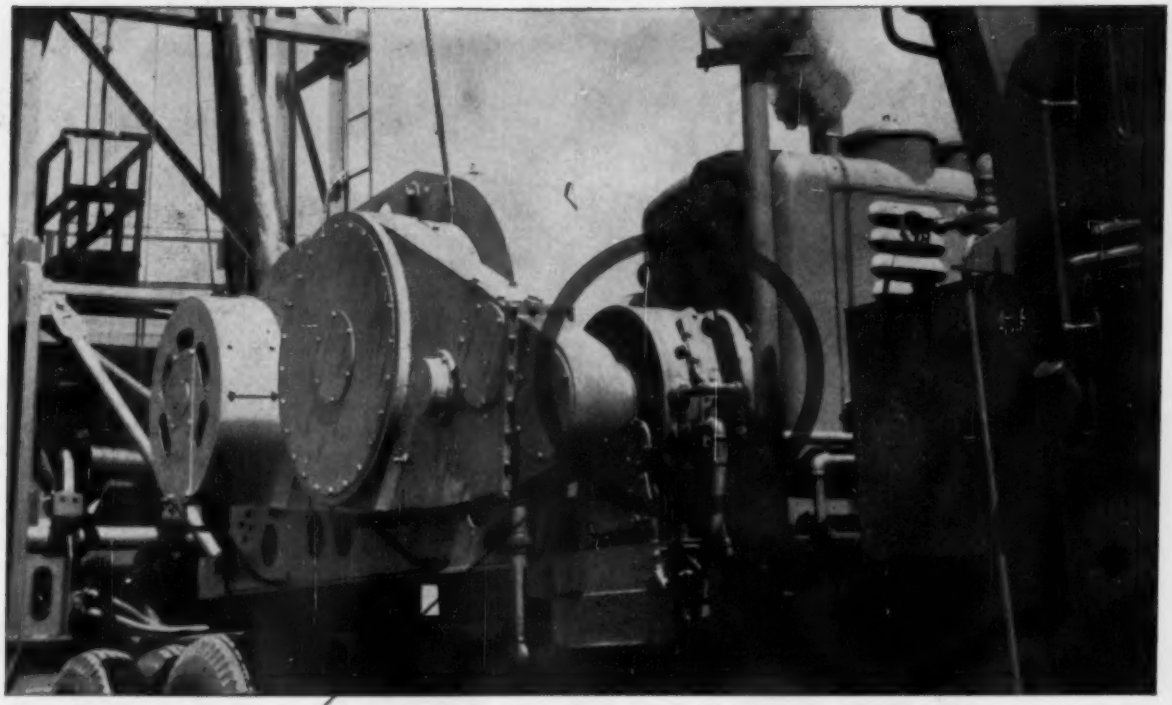
Reactors ...by Vogt

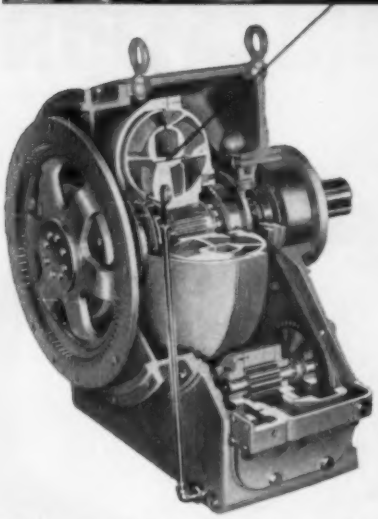
A bulletin describing the wide range of heat transfer equipment built by Vogt is available upon request.

Dept. 24A-XO

HENRY VOGT MACHINE CO., LOUISVILLE, KENTUCKY

BRANCH OFFICES: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.





How to make that engine deliver MORE WORK with LESS WEAR

CLARK Torque Converter

This you can depend on: any power plant, mobile or stationary, equipped with a Clark Torque Converter, will accomplish *more work with less wear.*

Smooth, shockless power-flow eliminates shock-loads, reduces wear of all working parts in the engine and in the power train. Result: less down-time, less maintenance, steady high efficiency through a longer, more useful life.

Take special note of these Quality Features

- **True Hydra-Foil Blade Design**—blade contour and angle assure maximum efficiency in torque multiplication
- **No Cavitation**—proper oil flow prevents turbulence and formation of air pockets, major causes of efficiency loss
- **High Engine Efficiency**—engine operates at its most efficient speed under varying torque demand
- **Self-Contained Oil Circuit**—sump cast integral; oil passages cored in housing. No hoses or unnecessary fittings—no external oil seals
- **Ideal Accessibility**—easiest inspection and maintenance. No special tools required
- **Size for Every Need**—horsepower 15 to 600; diameters 11 in. to 26 in.

Helpful literature sent promptly—use the coupon

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CLARK EQUIPMENT COMPANY, Falahee Road, Jackson 15, Mich.: Please send the CLARK Torque Converter Bulletin

Name_____ Position_____

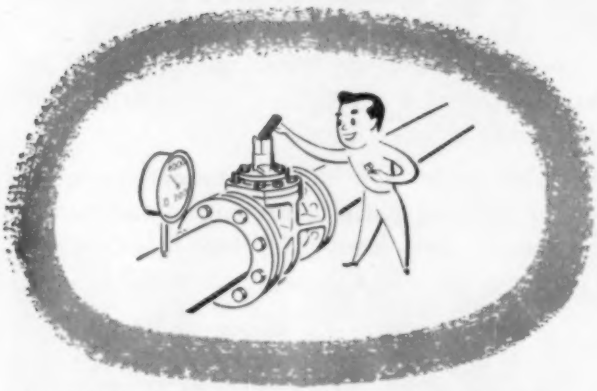
Firm_____ Address_____

City_____ Zone_____ State_____

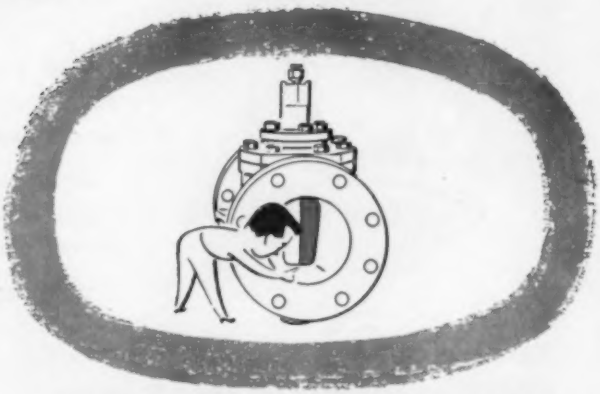
WHAT IS THE ADVANTAGE OF A LUBRICATED VALVE?—The most important advantage of a lubricated valve is that it *seals far tighter* than ordinary valves. The thin film of plastic lubricant forced into the ports of the plug is a pressure seal in itself. And the possibility of seizing or galling is eliminated because the plug can be hydraulically jacked for instant operation. Lubrication is also *preventive maintenance* against down time.

WHAT DOES THE LUBRICANT DO?—In a Rockwell-Nordstrom valve, lubricant is forced through grooves surrounding the plug ports where it acts as a *double seal* against leakage. By hydraulic action, lubricant under pressure also jacks up the plug keeping it free for *instant quarter-turn* operation. And lubrication means that operation is smooth and easy. Finally, lubricant prevents grinding wear for longer valve life at lowest cost.

DOES VALVE LUBRICATION ???



WHAT LUBRICANTS SHOULD BE USED?—Insist on genuine Rockwell lubricants—Rockwell is the largest and most experienced manufacturer of valve lubricants in the world. Rockwell lubricants are the result of years of field experience with nearly every process condition. For many services, there are variations of Rockwell lubricants compounded to offset specific line conditions. See your Rockwell sales engineer or write for Bulletin V-220 for complete details.

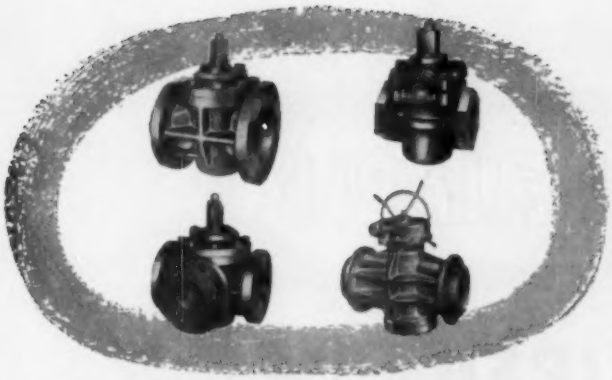


HOW LONG WILL PROPERLY LUBRICATED ROCKWELL-NORDSTROM VALVES LAST?—Many of the first Nordstrom valves put in service are still going strong. In gas distribution installations there are many valves with more than 30 years service. In a two-year paint plant study, Rockwell-Nordstrom valves were the only ones that did not need to be replaced because of leakage. Lubricant assures extra years of perfect service you can't expect from "dry" valves.

ROCKWELL

ROCKWELL-

LUBRICANT SEALED



WILL A ROCKWELL-NORDSTROM VALVE WORK WITHOUT LUBRICANT?—Yes, (even your automobile will function a short while without lubrication) but then the whole advantage of a lubricated valve is lost. Rockwell-Nordstrom lubricated plug valves are made to exceptional standards of tolerance and quality. However, it is their internal lubrication system which raises performance and economy standards far above any other type of valve.

HOW OFTEN SHOULD NORDSTROM VALVES BE LUBRICATED?—Basically, lubrication depends on service-temperature, process, frequency of operation, etc. Genuine Rockwell lubricants actually keep periodic lubrication to a minimum because they are specially compounded to handle specific services. Rockwell lubricant fittings of a button head type make the job fast, easy and every Rockwell-Nordstrom valve can be lubricated in service.

COST MONEY OR SAVE MONEY?

WHAT ABOUT MAINTENANCE COSTS?—Basically, lubrication is preventive maintenance against wear, replacement and down time costs. Also, lubrication—the key to leakproof, positive shut-off in Rockwell-Nordstrom valves—is an investment in safety and product loss or contamination. It's almost a mechanical axiom that *any* fully lubricated mechanism will require far less repair and parts replacement than a non-lubricated one.

YES, FOR 40 YEARS IT HAS BEEN PROVEN IN EVERY INDUSTRY THAT ROCKWELL-NORDSTROM LUBRICATED PLUG VALVES SAVE MAINTENANCE, REPAIR AND DOWN TIME DOLLARS. LUBRICATION IS AN INVESTMENT IN BETTER SERVICE, LONGER LIFE AND LOWER COST.*

**Note: First cost of Rockwell-Nordstrom valves is about the same—often lower—than ordinary valves.*

Rockwell-Nordstrom valves are available in semi-steel, steel, stainless and corrosion resisting metals and in a *full range* of sizes and pressures. For complete details on Rockwell-Nordstrom valves or Rockwell lubricants, see your supplier or write: Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

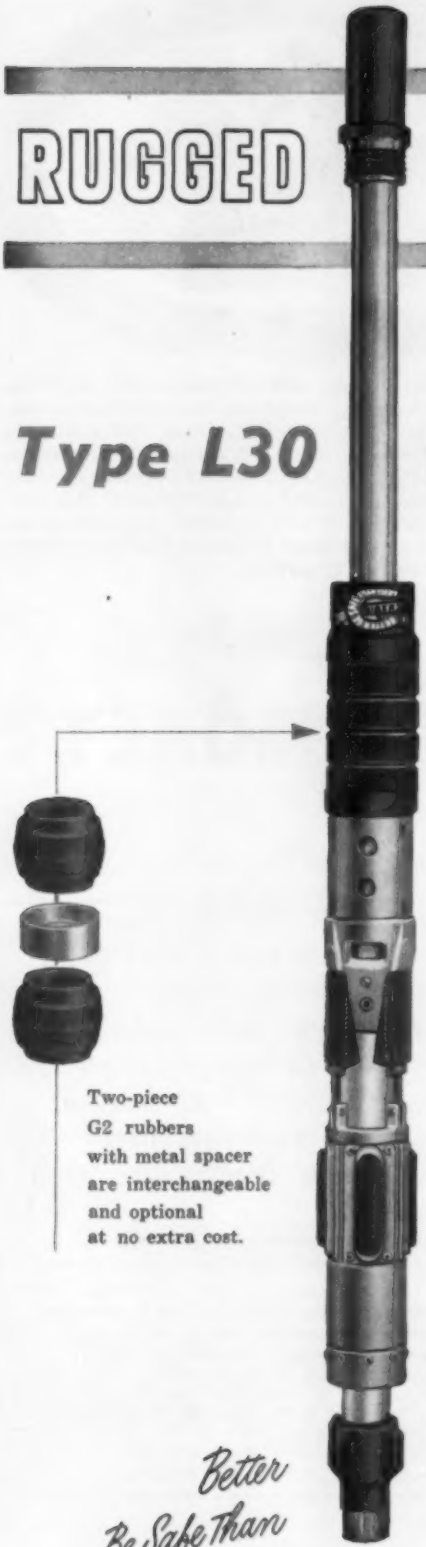
Nordstrom VALVES

FOR POSITIVE SHUT-OFF

RUGGED AND RELIABLE

GUIBERSON'S

Type L30 Deep Well Packer



Two-piece G2 rubbers with metal spacer are interchangeable and optional at no extra cost.

For deep well work with high temperatures and pressures, use Guiberson's dependable L30 Packer. It will give you long valve travel (30 inches) with minimum overall length at no extra cost. You can pull the L30 surely and safely. The fast-action automatic latch, protected by a positive anti-lock device that assures ready release, snaps easily into latched position. Tough, long-wearing friction pads supply ample drag. Packing rubbers of advanced design will not vulcanize to the casing wall. All these features are available on the L30 or the L8 with 8" valve stroke in a wide range of casing sizes. For circulating *above* the packer, Type L30P or L8P with perforated mandrel is available.

Better Be Safe Than Sorry

THE GUIBERSON CORPORATION

ESTABLISHED 1919
DALLAS, TEXAS
U. S. A.

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This is the George W. Behnen family of Affton, Missouri, relaxing in the living room of their comfortable home. Seated on the floor are Mike and Kathy. Others (l. to r.) are Judy, Mr. Behnen, Julie, Tony, George Jr., and Mrs. Behnen.

You ought to meet the rest of this Missouri family!

Big healthy families like the Behnens are a tradition in Missouri. Mr. Behnen is a Standard Oil salesman, and we wish you could meet the rest of the family *he* belongs to, the other members of his *Standard Oil family* who live and work in this state. How many folks would you suppose we're talking about?

First there are our employees, hundreds of men and women, people like the Behnens, who live in cities and towns throughout the state and work in our offices and in the field to help our dealers and agents serve you better.

Then there are the friendly men you know so well, the more than 1,200 independent businessmen who run the Standard stations serving you all over Missouri. And, of course, our agents, some 250 men working for and with Missouri farmers, winter and summer, bringing them the many petroleum products so important in the modern, efficient farming practices for which the Show Me State is noted.

The total number of Standard shareholders in Missouri at the last count was 6,543. Standard Oil stock is held by retired teachers and new babies, by farmers, ministers, bankers, union leaders and public servants. Institutions, too, such as colleges, banks, hospitals and insurance companies are stockholders in our company. And, we're proud to say, scores of our own employees in Missouri own stock in the company as well.

Like other Missouri families, we pay taxes, too. For instance, in addition to federal taxes of various types, Standard Oil pays taxes which go to support local and state governments in Missouri. Also, in accordance with your laws, we collect taxes from customers and turn the money over to your government.

*** What makes a company a good citizen?**

Citizenship is a privilege. A good citizen assumes the responsibilities toward his community which accompany this privilege. Standard Oil Company and its people assume these responsibilities by trying at all times to contribute to the security, the economic well-being, and the general welfare of the communities in which they live and work.

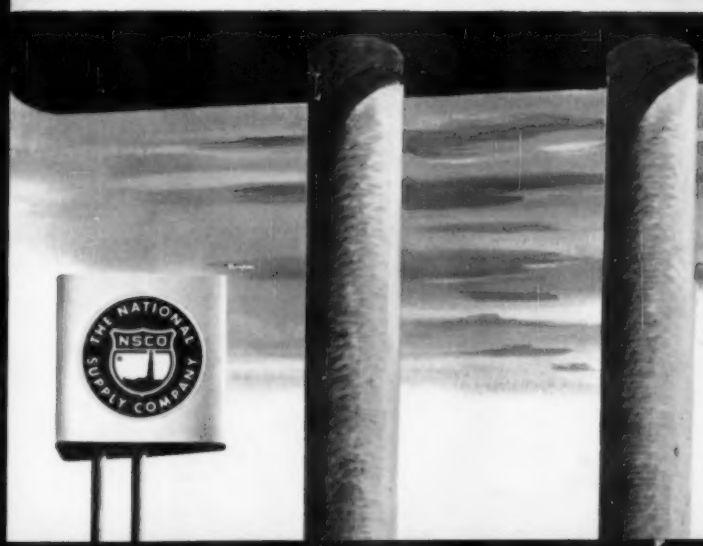
Tom Ryan is an accountant at Standard's St. Louis office. He is one of hundreds of persons employed by Standard Oil in Missouri. In turn, this makes more business for other Missouri companies—and more jobs, too.

One way you can actually see a tax! It's a new public school in St. Louis. Each year Standard Oil pays many thousands of dollars in local and state taxes which help support community and state services.

A. H. Bates of Springfield recently retired after 31 years of service with Standard Oil. He has been one of our stockholders since 1927. And, by the way, Standard this year paid dividends to Missouri owners for the 64th consecutive year.

STANDARD OIL COMPANY (INDIANA)

If you live in Missouri, you probably have seen this ad. Or, if you live in one of the other Mid-American states where Standard Oil products are sold, you may have seen an advertisement like it. Such advertising helps develop public understanding of the contributions the oil business makes to the general welfare of the communities it serves.



You'll solve more operating supply problems here!

It's always good business to anticipate the need for supplies before it occurs. You'll save time and money when you do this at a National Store.

(*Continued on next page*)

(*Continued from preceding page*)

Come into a National Supply Store and we'll prove it to you. First, you'll see an extensive inventory of brand name tools, parts, accessories and supplies—displayed in bins, counters and warehouse areas for your personal examination and selection. Actually, you have all the buying conveniences of a modern supermarket, including up-to-date price information. You can plan and buy most efficiently when you shop in the store!

You can also get more useful product information at a National Store. Maintenance instructions, charts of equipment ratings and other helpful bulletins are available. You'll find technical descriptive bulletins on drilling and production equipment and accessories.

Finally, you can see for yourself *new* products and improvements in old ones when you stop at a National Store. This is a big advantage you gain by personally visiting the store. You get a first hand picture of what new equipment or methods may mean in improving your operations.

Complete stocks, complete product information and everything that's new . . . the crew in the National Supply Store nearest you is always ready to provide these advantages for your operation.

Below, a Spang inspector uses a master gauge to check thread accuracy on Extreme Line Casing at National's Ambridge, Pa., plant —one of the nation's largest plants for the exclusive production of oil field tubular goods.

Precision manufactured SPANG® Extreme Line Casing is the finest you can buy

When the chips are down and there's likely to be trouble, most operators insist on SPANG Extreme Line Casing. When well conditions dictate that only the finest casing can be used, SPANG Extreme Line again gets the nod. Naturally, a long history of exceptional performance in every type of well has built such a reputation for this SPANG product.

Two major ingredients are responsible: The SPANG Extreme Line Casing Joint *and* the extremely accurate manufacturing processes used to produce this casing. The design of the joint means that it is easy to run and re-run repeatedly—it is 100% leak-resistant and has high joint strength—it is streamlined for maximum running efficiency and clearance—it has a minimum number of threaded connections.

The special steps taken to produce this casing mean it will give you the high quality performance required. From ingot steel to barge or gondola car, the making of Extreme Line casing is checked many times, many ways. Countless lab tests and many inspections (including the new Magnaglo process in grade P-110) are used to assure its high quality.

Remember these important ingredients when you consider the requirements for your next well. Talk it over with the people who have *specialized* in high quality oil field tubular goods for over 40 years—National Supply's SPANG Division and its representatives in your area.

SPANG-CHALFANT DIVISION

MAIN OFFICE: Two Gateway Center, Pittsburgh 22, Penna.
DIVISION TUBULAR OFFICES: Dallas, Texas; Denver, Colorado; Houston, Texas; Los Angeles, California; New York, N. Y.; Toledo, Ohio; Tulsa, Oklahoma; Calgary, Alberta, Canada
NATIONAL BLUE OIL FIELD MACHINERY AND EQUIPMENT
SPANG STEEL PIPE AND ELECTRICAL CONDUIT

THE NATIONAL NSCO SUPPLY COMPANY

Need top-quality Spang CW pipe for general service work?

See the next page

Top quality... SPANG® CW Steel Pipe for oil field service

When it comes to laying dependable gathering or feeder lines in a hurry, high quality SPANG CW can really help your schedules. Because it is made under the same quality control conditions as SPANG oil field tubular products, you'll find it easy to work with . . . easy to cut, bend, thread and weld. It will save time on the job, give you faster installations . . . and years of rugged service.

Why not check at the nearby National Supply Store now. There, you'll find available all sizes of SPANG CW—plain end or threaded and coupled—to meet your service pipe needs . . . for gas lines, water lines, oil lines.

SPANG-CHALFANT DIVISION

MAIN OFFICE: Two Gateway Center, Pittsburgh 22, Penna.
DIVISION TUBULAR OFFICES: Dallas, Texas; Denver, Colorado; Houston, Texas; Los Angeles, California; New York, N. Y.; Toledo, Ohio; Tulsa, Oklahoma; Calgary, Alberta, Canada
NATIONAL BLUE OIL FIELD MACHINERY AND EQUIPMENT
SPANG STEEL PIPE AND ELECTRICAL CONDUIT

TI ANNOUNCES DATA GAGE*

Remote Liquid Level Measurement System

The DATA-GAGE is the direct product of Texas Instruments working closely with the engineers of a leading oil company. The result is the first transistorized automatic tank gauge that gives you *triple-check* reliability, dependable Power Float accuracy to 1/16 inch, low maintenance, operational simplicity, and 100-tank capacity in ONE LOW COST SYSTEM!

Eliminates Costly Errors—DATA-GAGE does not depend on alertness of operator to catch errors. System *automatically triple-checks* itself for accuracy before any data is displayed: 1. Operational check of Power Float; 2. Identification of tank connection; 3. Telemetering check for correctness and completeness of data.

Dependable Accuracy Under All Conditions—1/16 inch accuracy at depths of zero to 64 feet. No need to recalibrate over a wide range of liquids, temperatures and specific gravities. DATA-GAGE is the *only* system to give reliable readings during blending turbulence.

Low Initial and Long-range Cost—DATA-GAGE is a complete measurement system requiring no expensive extras. No special transmission system or conduits are required at installation—often existing ground level gauge connections and pipes can be utilized. Transistors are used instead of short-lived vacuum tubes. Easy access and quick-disconnect parts in all units make this the easiest to service of all systems.

Operational Simplicity—operator simply dials tank number and awaits data to be displayed seconds later on the exclusive DataFLASH reading panel. He need not make comparative readings to determine errors—DATA-GAGE automatically checks itself.

Power Float Reliability—the mechanical surface finder is a moving rather than static float, registers the instant surface tension is broken. No possibility of tilting, locking or sticking and giving an erroneous reading.

Proved Telemetering—true digital system employs digital code in binary decimal form. Means of transmission is a completely redundant (code group and its complement are transmitted), three-state code, the reliability of which has been thoroughly proved in transatlantic telegraphy.

Utmost Safety Precautions—field units are plug-in type which may be removed to safe area for servicing. No electric wires enter the tank. Explosion-proof housings are available on all field units.

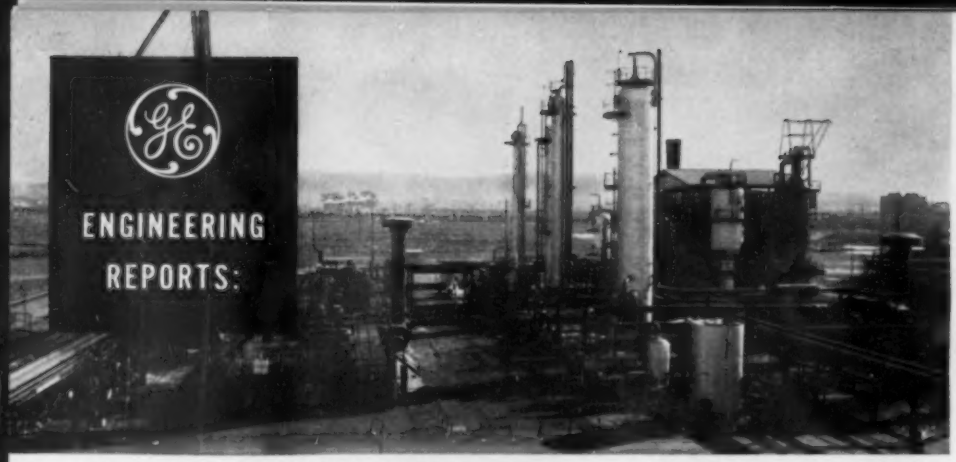
For complete detailed information on the modern DATA-GAGE system, write for Bulletin No. M-601.

TEXAS INSTRUMENTS INCORPORATED

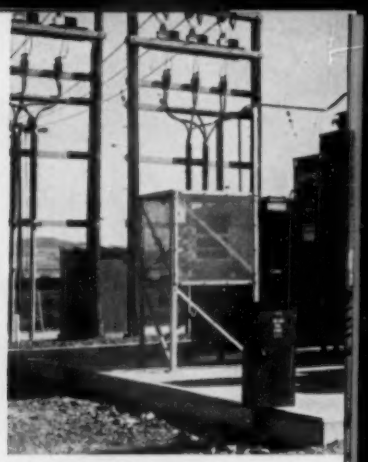
INDUSTRIAL INSTRUMENTATION DIVISION

3609 BUFFALO SPEEDWAY • HOUSTON, TEXAS • CABLE: HOULAB

*TRADEMARK REGISTRATION APPLIED FOR.



BUILT IN 14 MONTHS by The M. W. Kellogg Co., new ammonia plant is a unit of Standard's Richmond refinery, one of West's largest. All electric equipment is by General Electric, which also provided engineering service to help achieve fast start-up.

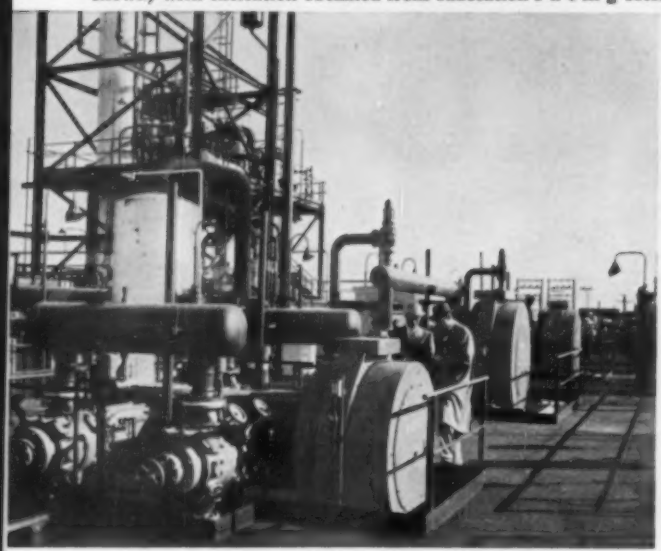


CO-ORDINATED for top reliability, G-E equipment in master substation for ammonia

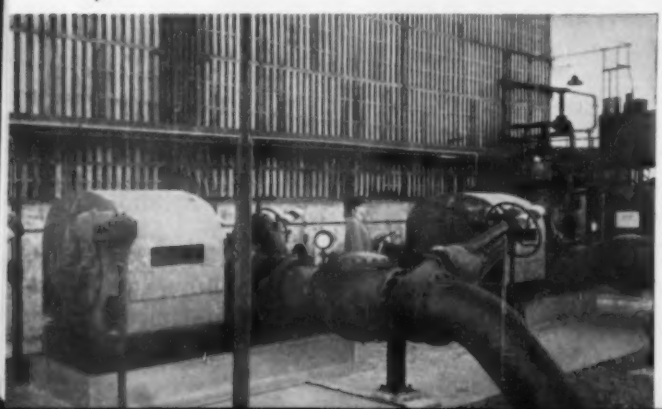
At Standard's Richmond, Calif., refinery . . .

General Electric engineering services help

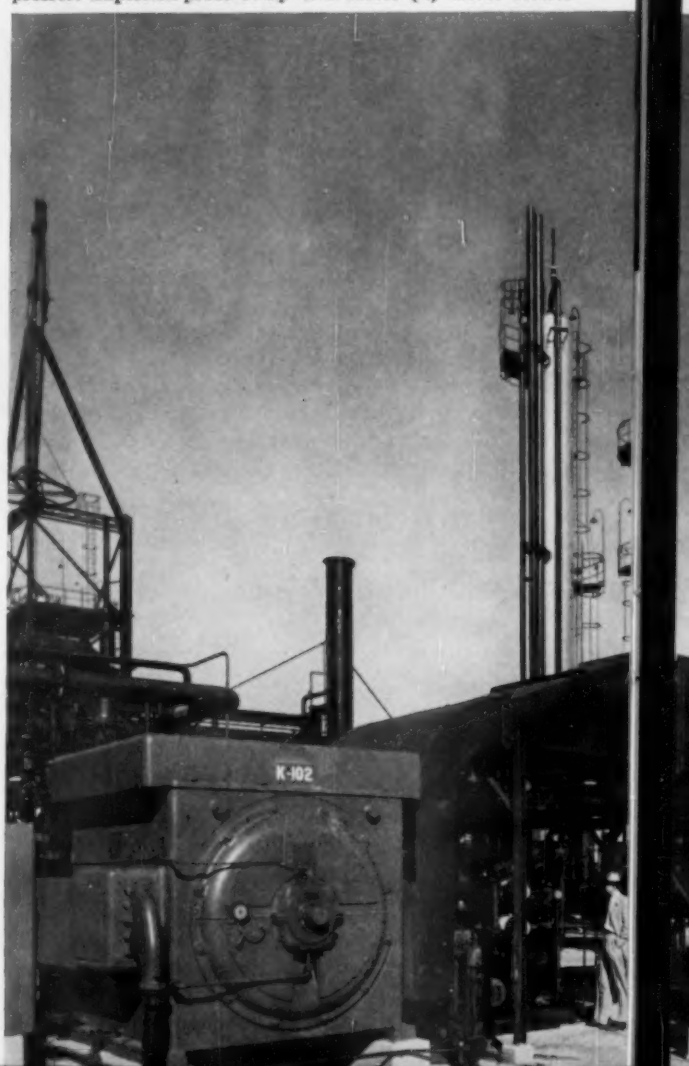
OUTDOOR-LOCATED on platform to drive compressors are 8 high-efficiency, enclosed, force-ventilated G-E synchronous motors (3 shown) with excitation obtained from substation's d-c m-g sets.

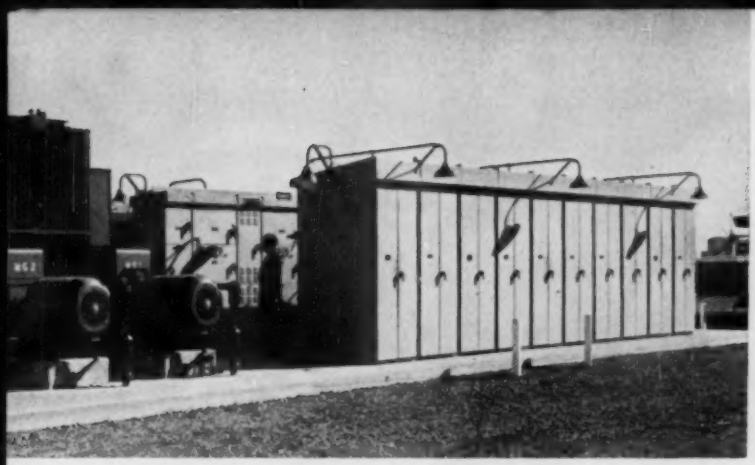


WEATHER-PROTECTED, 2 rugged 350-hp G-E induction motors drive cooling-water pumps. Other plant induction motors are either enclosed force-ventilated or explosion-proof, fan-cooled.



PLANT'S BIGGEST, a 4000-hp 12,000-v totally enclosed force-ventilated G-E induction motor drives synthesis gas compressor. Explosion-proof 60-hp G-E motor (r.) drives blower





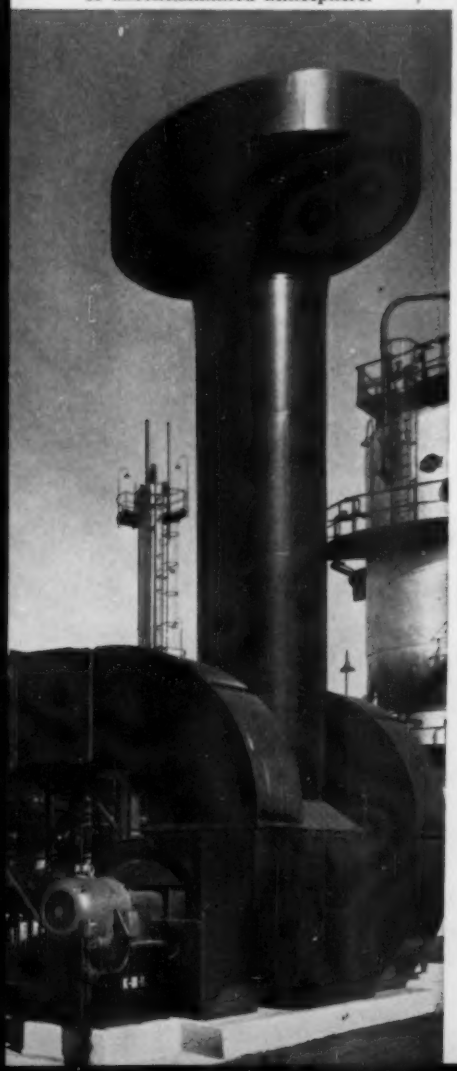
plant includes 5000-kva transformer, 17 units of 12-kv metal-clad switchgear, 2300-v Limitamp* motor starters, 480-v outdoor motor control centers, 2 outdoor motor-generator sets, and two 480-v transformers.

*Registered trade-mark of General Electric Co.

EASY MAINTENANCE of plant's G-E metal-clad switchgear is shown by workman removing vertical-lift, magne-blast circuit breaker for inspection.

speed opening of 300-ton/day ammonia plant

drawing clean air—via black ductwork and mushroom tower—from upper level of uncontaminated atmosphere.



General Electric power system, installed to meet rigid construction schedule, helps plant get fast start on profitable production

Standard Oil Company of California, Western Operations, Inc., recently added to its Richmond, California refinery—the largest west of the Rockies—a new $11 million ammonia plant designed, engineered and built by The M. W. Kellogg Co. The plant's capacity of approximately 300 tons per day of anhydrous and aqueous ammonia is shipped to nearby California Spray Chemical Corp., a subsidiary, for conversion into fertilizer.

GENERAL ELECTRIC supplied the new plant's electric equipment—compressor drives, auxiliary motors, and complete outdoor substation with co-ordinated components. In addition, General Electric engineering services helped both customer and designer get the new plant from the discussion stage to on-stream in only 14 months.

An example was the contribution of General Electric installation and field service engineers. By supervising the installation of the electric equipment as scheduled deliveries arrived, they helped reduce field installation costs, speed completion of construction schedules, and hasten start-up time. To Standard, this meant getting into production faster, and thereby, showing a return sooner on the large capital investment tied up in the plant.

IN ADDITION, the 17,000-kva block of power will be integrated into the existing plant system. General Electric application engineering services, working closely with Standard and Kellogg representatives, helped provide the electrical equipment co-ordination and integration necessary to meet the plant's process power requirements.

For *your* new chemical plant, too, General Electric offers a one-manufacturer source of quality electric equipment and valuable engineering services to help provide you and your process contractor with an efficient, co-ordinated electrical system. Early in your planning, contact your nearest General Electric Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y. 662-49

Engineered Electrical Systems for the Process Industries

GENERAL ELECTRIC

LEE C. MOORE MASTS HAVE . . .

DESIGN VERSATILITY

to fit your specific needs

LEE C. MOORE designs cantilever masts to accommodate any type and size of drawworks and power combination. Our close collaboration with other manufacturers assures the drilling industry of drilling rigs best suited to specific requirements.

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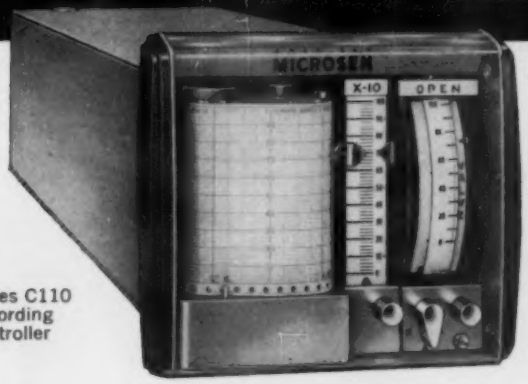
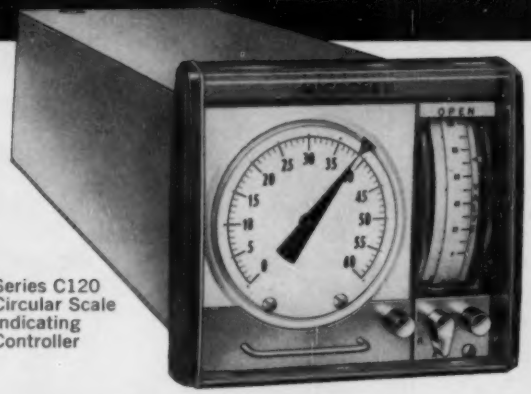
NEW TRANSISTORIZED ELECTRONIC CONTROLLERS Interchangeable for complete versatility



Series C110
Recording
Controller



Series C120
Circular Scale
Indicating
Controller

The new 'American-Microsen' Series C100 Electronic Controllers can be interchanged at the panelboard in seconds. A recording controller to an indicating type . . . a proportional-action controller to proportional-plus-reset . . . slow reset to fast reset – any of these replacements is quickly made by pulling one unit out and plugging in the other.

The controller settings of the 'American-Microsen' System are all calibrated and repeatable. When a controller station is replaced, the proportional, reset and rate settings can be made in advance so the process is on control the instant the changeover is completed. No playing around to tune in the control.

When the process is on manual control during a replacement operation, the controller station stays in balance with the actual valve position. Thus the process can be changed back to automatic control without "bumping" or upset. A unique feature of the 'American-Microsen' System eliminates any "balance" or "seal" position between manual and automatic.

These are but a few of the many functional advantages of the new 'American-Microsen' Electronic Control System. Join the many satisfied users of this new approach to process control. Make certain you have the better control and simplified servicing so essential to higher product quality and greater operating economy. Arrange for a meeting with one of our sales engineers to determine the best equipment for your service. *Write for Bulletin RC100.*

Controller Performs These Functions

Measures input signal from transmitter and records or indicates in terms of the measured variable — pressure, temperature, flow, etc. (The Series C110 records on a 3-inch wide strip chart, the Series C120 indicates on a 4-inch diameter scale.)

Provides means of setting the desired value of the measured variable (set point) and compares actual value with desired value.

Transmits control signal, incorporating proportional, reset, and/or rate actions to operate final control element.

Provides means to operate control element manually with simple switch and manual knob.

Ultra-Modern Features Provided

All functions of recording (or indication), controlling (proportional, reset, and/or rate), and manual valve operation *in a single housing.*

Transistorized controller station for ultimate reliability and long service life.

Printed circuitry and miniaturized components for space-saving simplicity.

Plug-in units for complete interchangeability and ease of maintenance.

Ratio, cascade, and other similar control arrangements, using standard instruments.

Direct bumpless transfer from manual to automatic control with no intermediate position.

DC signals of 1.0 to 5.0 milliamperes for instantaneous distance transmission up to 30 miles.

Controllers are compatible with any unit of other manufacture using the standard 1 to 5 milliampere DC signal.

MANNING, MAXWELL & MOORE, INC.

MANNING MAXWELL & MOORE INC. M&M TRADE MARK

INDUSTRIAL CONTROLS DIVISION • STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN-MICROSEN' ELECTRONIC INSTRUMENTS FOR MEASUREMENT, TRANSMISSION AND CONTROL

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OIC Valves, Bronze, Iron, Cast, and Forged Steel for all purposes.

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OIL STATES EQUIPMENT COMPANY
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Mansfield, Ohio
Centrifugal Pumps.

STEEL FORGINGS, INC.
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HARRISBURG STEEL CORPORATION
Harrisburg, Pennsylvania
Forged Steel Flanges and Seamless Casing Couplings.

VOLCANO BURNER COMPANY
Houston, Texas
Volcano Superior and Gulf States All Steel Gas Burners for OIL COUNTRY BOILERS.

LOS ANGELES BOILER WORKS, INC.
Los Angeles, Calif.
Welding Cups—Dished & Flanged Heads.

WESTERN SAFETY BARREL STAND
Houston, Texas
Stand lifts, holds, tilts 55 gal. barrels Prevents spillage—easily loaded.

MILLS IRON WORKS, INC.
Los Angeles, Calif.
Seamless Swage Nipples, Bull Plugs & Welding Reducers.

WHEELING MACHINE PRODUCTS CO.
Wheeling, West Virginia
XL Steel Pipe Couplings for OIL COUNTRY TUBULAR PRODUCTS.

They Say—

Small business section a hit

Dear Sir:

Honestly, your section on "Small Business in Oil" is inspiring. At this particular time when things in the contract drilling and oil producing business aren't as lush, let us say, as they have been, your article seemed to give me a boost. Being one of those who started from nothing and now has some production and a good drilling rig, I felt the article was written about our company. The oil business is a wonderful example of the American way, and may we always have the opportunity of making our own way.

Another thing which I feel should be mentioned is the feeling which the employes of small drilling and producing companies have for their respective companies. It appears to me that the small contractor or producer with three or four key personnel in his office enjoys a special kind of loyalty and devotion to duty not found in the offices of the major companies. At least I say this unreservedly on behalf of my own coworkers.

Again, I really enjoyed your article. I would like to have 25 reprints when they are available.

Stuart G. Noah
Noah Petroleum Co.
Albion, Ill.

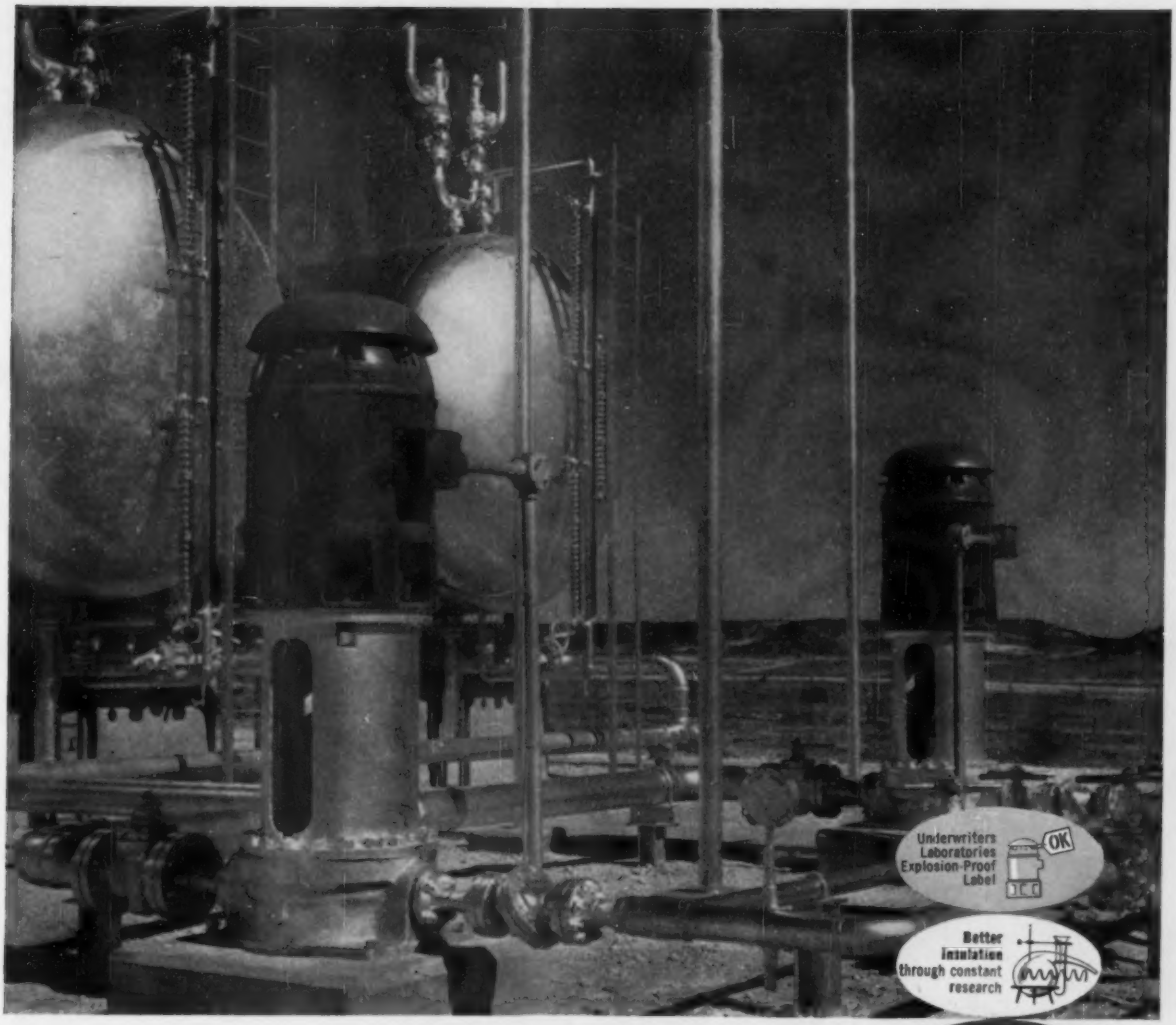
Editor's note: The Journal's special section "Small Business in Oil" appeared in the November 18 issue, pp. 255-268. It tells about the important part of the "little man" in exploration, drilling, producing, refining, and pipelining. Free reprint copies are available. Address Reader Service Department, P. O. Box 1260, Tulsa 1, Okla.

Government has foot in door

"I think that our present oversupply problem has its roots in three things.

"First, the consumption of oil in this country this year has not fully kept pace with earlier estimates. Second, we probably did not readjust our output fast enough following the reopening of the Suez Canal. And finally, considering these first two points, there is no doubt that crude-oil imports into this country reached too high a level . . .

"To my way of thinking it is imperative that each individual and each company which is affected by the



Here's dependable all-weather power

Louis Allis vertical motors are designed for outside petroleum installations

Here's a pump drive keyed to match the particular specifications of the petroleum industry.

Louis Allis vertical solid-shaft motors are explosion-proof for operation in hazardous locations, and corrosion-resistant to ward off both the etching acids in cat-cracking plants and the corroding action of salt spray at sea-exposed installations.

Tough, impervious insulation plus well-designed fully-enclosed construction give ample protection against weather, including dust- or rain-storms.

These motors are no problem for maintenance men, either. Easily mounted and wired up, they require little care afterwards. Tested quality bearings and ample lubrication reservoir keep them trouble-free. The locked bearing construction assures long life.

Louis Allis has a complete line of Explosion-Proof motors, with speeds to 3600 rpm., and sizes up to 600 hp. Ask for Bulletin 800 at your nearby Louis Allis District Office or write The Louis Allis Co., 449 East Stewart Street, Milwaukee 1, Wisconsin.

LOUIS ALLIS

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

high pressure?

next time specify orbit forged steel valves for your 6,000 and 10,000 lbs. test christmas trees

they operate easy

Orbit valves meet all the special requirements of Christmas Trees for high pressure production operations. Full round straight through passage, positive closure without lubrication — compact body design for reduced overall weight. Further savings can be realized by using ORBIT'S 2" x 1" Venturi in place of a full 2" opening valve on tubing wings. When consulting with your favorite Well Head Manufacturer on your pre-fabricated Christmas tree drawings be sure to specify Orbit forged steel production valves. Orbit Valves are available through all Well Head Manufacturers.

at your favorite Well Head Manufacturer.

ORBIT VALVES

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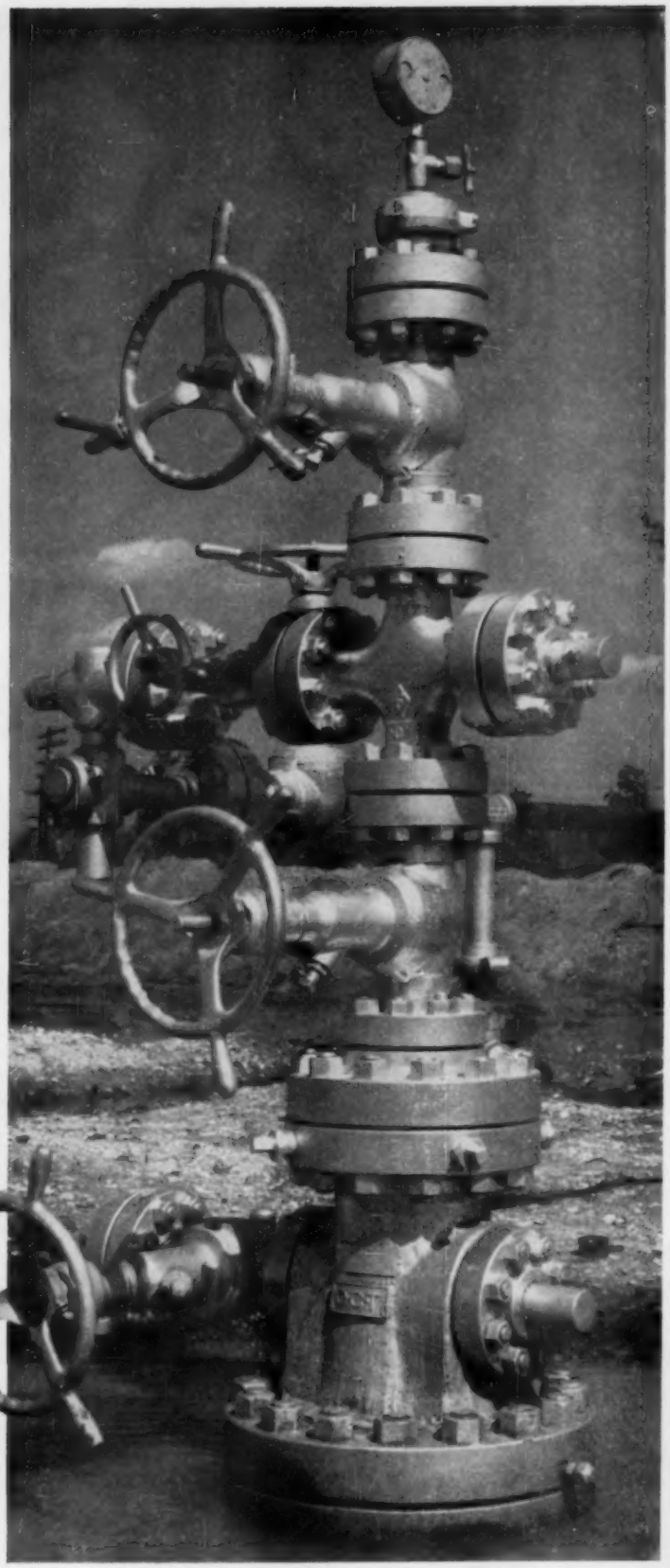
WEST COAST REPRESENTATIVE: Fred P. Koenig Company, Long Beach, Calif., 3815 Atlantic Avenue, GArfield 4-3834

CANADIAN REPRESENTATIVE: T. R. Pickford & Company, Ltd., Calgary, Alberta, 536 8th Avenue West, Phone 2-7371

EXPORT REPRESENTATIVE: New York, 36, N. Y., 500 Fifth Avenue, BRyant 9-2236



imports problem—be they domestic producers, importers, or both—be fully aware of the risk it is running in not handling the problem satisfactorily—and doing it voluntarily. I mean the risk of more government control of our industry.

"The federal Government already has a foot in our back door by way of the Supreme Court's action on natural gas. Getting it out has turned into a long, uphill struggle. If the Government should pry open our front door—or worse yet, if we should open it for them—our house will soon no longer be our own."

Monroe J. Rathbone, president, Standard Oil Co. (N.J.), in a speech to the Independent Petroleum Association of America.

California problem unsolved

"Conservation programs in California may be carried on through private, voluntary agreements, (but) such programs may still be frustrated by operators who do not choose to participate. A real need remains for legal mechanisms to bring about oil conservation, not merely where it is expedient but wherever it is needed."

T. S. Petersen, president, Standard Oil Co. of California, in a speech to the Western College Association, San Jose, Calif.

TIPRO's pipeline petition

"Probably the most important action taken by TIPRO to date (on imports and unconnected wells) on the state level was a petition which we filed, together with the regional associations, asking the Texas Railroad Commission to compel the expansion of crude oil common carrier pipelines and to lay ground rules for the connection of wells . . .

"In our brief we showed that trunk and gathering line capacity, not just in West Texas, but throughout the state, had lagged behind the increase in reserves, productive capacity, and the number of new wells. We showed that some crude-oil pipelines had been converted to product lines without the consent of the Railroad Commission.

"And most important, we went out into the oil fields and counted the wells that had no pipeline connections. In all, there were almost 8,400 of them, and of these, more than 6,000 were in fields where other wells were connected. Most of these unconnected wells showed no outward reasons for being considered uneconomic or unprofitable to connect.

"We showed, further, that since 1939 crude-oil trunk line and gathering line capacity have increased far less than production, and that while state production increased 257 per cent, production without pipeline connection increased 738 per cent. Thousands of operators are having to truck their oil at costs ranging from 15 to 45 cents per barrel, and a growing number are finding it impossible to sell oil even when they truck it right to the refinery gate."

Jerome J. O'Brien, president, Texas Independent Producers and Royalty Owners Association, in a speech to the Independent Producers and Royalty Owners Association of New Mexico, in Albuquerque.

CALENDAR

DECEMBER

1-6 American Society of Mechanical Engineers, annual meeting, Statler Hotel, New York.

2-6 Twenty-sixth Exposition of Chemical Industries, Coliseum, New York.

6 American Institute of Mining, Metallurgical, and Petroleum Engineers, Basin chapter; University of Illinois, petroleum engineering department; Illinois State Geological Survey; symposium on fracturing, University of Illinois campus, Urbana, Ill.

6-11 American Institute of Chemical Engineers, annual meeting, Conrad Hilton Hotel, Chicago.

LION E-120 COATING

Priced Lower than conventional coatings, LION E-120 has many other characteristics which result in savings without sacrifice of the quality required by corrosion engineers of the oil and gas industry.

Greater Coverage per ton, due to its specific gravity, cuts cost per foot for a given thickness of coating.

Labor Savings result from packaging in easy-to-handle, easy-to-chop containers weighing from 120 to 175 pounds.

Favorable Insurance rates at substantial savings are offered and extra labor costs are avoided because LION E-120 has no toxic fumes—creates no safety hazard.

Write for complete specifications on this cost-cutting LION E-120 *coating. And ask for literature on other* HOLCOMBE *corrosion prevention products.*

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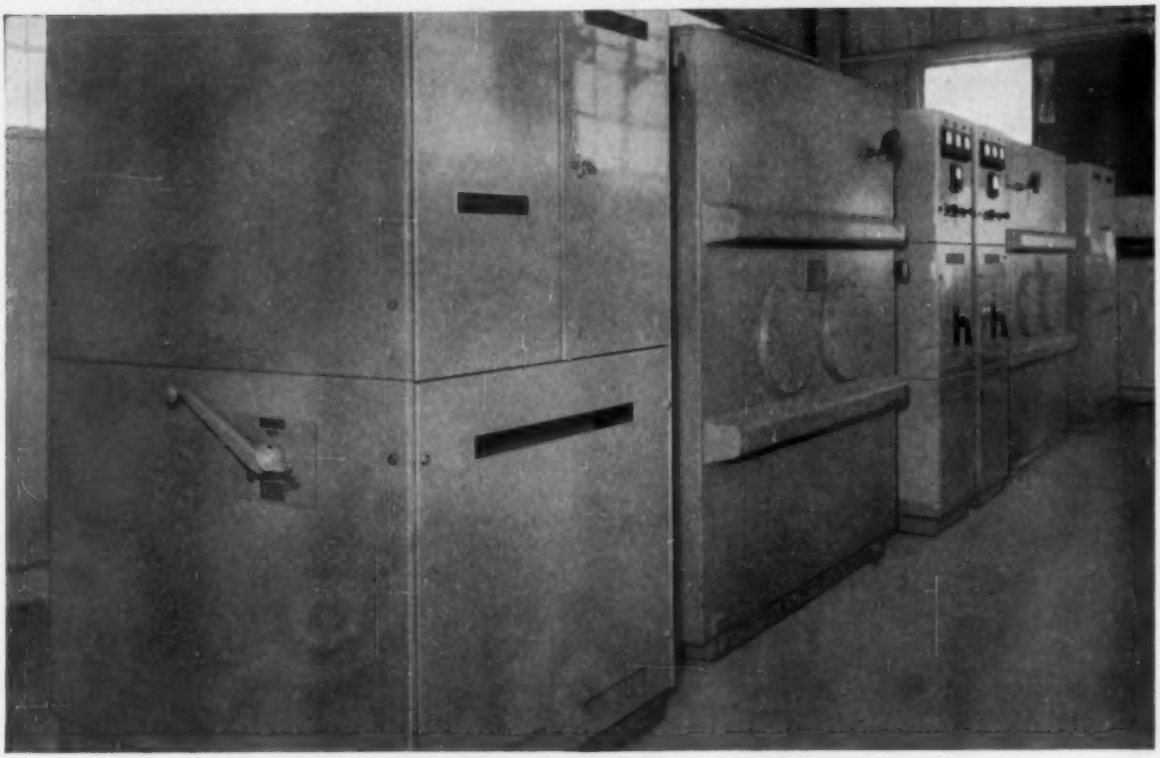
WAGNER TRANSFORMERS...THE CHOICE OF LEADERS IN INDUSTRY



Wagner Sealed Dry-Type Transformers can serve under the most adverse conditions

Impervious to DUST, LINT, HUMIDITY, HIGH AMBIENT TEMPERATURES, FLOODING—no need for vaults or barriers

Here's a unit substation transformer that you can safely install in any load center—any place—no matter how tough the operating condition.

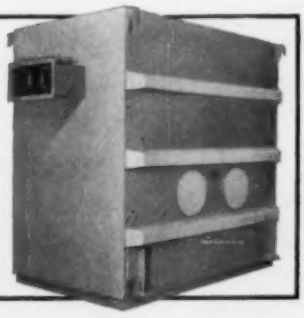
Wagner Sealed Dry-Type Transformers are hermetically sealed in a welded steel case to provide positive protection from contamination, fire and explosion hazards.

Class H insulation is used throughout the transformer. Core and coils are impregnated with silicone varnish and are sealed in the case which contains inert-dry-nitrogen under pressure to prolong insulation life. Maintenance is reduced to periodic checking of bushings case and gas pressure.

Available in ratings from 300 to 2000 kva, 5 or 15 KV high voltage, 480 volts low voltage. For complete information on these sealed dry-type transformers, write for Bulletin TU-214 or call the Wagner branch office near you.

PREDESIGNED
to save you money

Wagner Nitrogen-Filled Dry-Type Transformers save you individual job engineering time and cost. That's because they are PRE-DESIGNED in standard ratings coordinated with the specifications of unit substation switchgear builders. These standard designs assure quicker delivery of the correct transformer for your load center installation.



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10-11 University of Oklahoma, second annual conference on water quality control for subsurface injection, sponsored by the School of Petroleum Engineering, Extension Study Center, Norman, Okla.

JANUARY

11-12 National Oil Scouts and Landmen's Association, directors' meeting, Adolphus Hotel, Dallas.

16-18 Association of Oilwell Servicing Contractors, second annual convention, Baker Hotel, Dallas.

19-22 Pipe Line Contractors Association, tenth annual convention, Boca Raton Hotel and Club, Boca Raton, Fla.

31 Natural Gasoline Association of America, regional meeting, Skirvin Hotel, Oklahoma City.

FEBRUARY

12-14 National Association of Corrosion Engineers, Tulsa section, ninth annual corrosion short course for pipeliners, Mayo Hotel, Tulsa.

13-15 National Society of Professional Engineers, spring meeting. Michigan State University, East Lansing, Mich.

16-20 American Institute of Mining, Metallurgical, and Petroleum Engineers, annual meeting, Hotel Statler, New York.

26-28 American Petroleum Institute, Division of Production, southern district meeting, Shamrock-Hilton Hotel, Houston.

28 Natural Gasoline Association of America, Permian basin regional meeting, Lincoln Hotel, Odessa, Tex.

MARCH

3-4 Society of Petroleum Engineers of American Institute of Mining, Metallurgical, and Petroleum Engineers, fourth annual joint meeting of Rocky Mountain petroleum sections, Cosmopolitan Hotel, Denver.

5-6 Gas Conditioning conference, sponsored by the University of Oklahoma, Oklahoma Memorial Union Building, Norman, Okla.

7 Ohio Oil and Gas Association, winter meeting. Deshler Hilton Hotel, Columbus, Ohio.

10-13 American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists, forty-third annual meeting, Biltmore Hotel, Los Angeles.

12-14 American Petroleum Institute, Division of Production, southwestern district meeting, Hotel Texas, Fort Worth.

17-21 National Association of Corrosion Engineers, annual conference, civic auditorium, San Francisco.

17-21 International Atomic Exposition, Inc., 1958 Nuclear Congress, Chicago Amphitheatre, Chicago.

20-21 New England Gas Association, annual meeting Hotel Statler, Boston.

20-21 Society of Petroleum Engineers of American Institute of Mining, Metallurgical, and Petroleum Engineers, regional conference on production and reservoir engineering, Mayo Hotel, Tulsa.

24-26 Midwest Gas Association, Broadmoor Hotel, Colorado Springs, Colo.

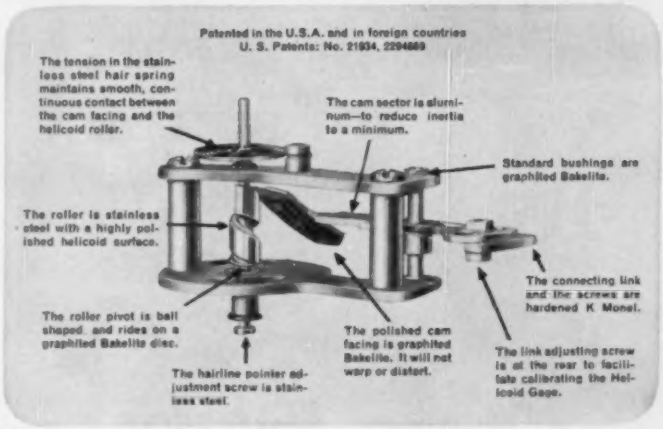
31-April 2 American Petroleum Institute, Division of Transportation, annual pipeline conference, Jung Hotel, New Orleans.

APRIL

1-3 University of Oklahoma, fifth annual conference on corrosion control, Extension Study Center, Norman, Okla.

Nothing but the best in gages for working pressures from 30" vacuum to 10,000 p.s.i.

These details of Helicoid gage design assure longer life and enduring accuracy


Patented in the U.S.A. and in foreign countries
U. S. Patents: No. 21934, 2294689
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is aluminum—to reduce inertia to a minimum.
Standard bushings are graphited Bakelite.
The roller is stainless steel with a highly polished helicoid surface.
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The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
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The superiority of Helicoid Gages is most evident in severe service—wherever a gage is subjected to violent pressure pulsations or severe mechanical vibrations.

The *sustained accuracy* of Helicoid Gages over *millions of cycles* is explained by the details of design and construction of the Helicoid movement shown above. Such Helicoid features—protect against wear and corrosion and assure sensitivity, sustained accuracy and trouble-free operation.

Easiest adjustment and calibration

Only Helicoid Gages have the external pointer adjustment pictured here. The Helicoid type adjustment cannot be jarred out of position.

Calibration of Helicoid Gages is accomplished easily, without removing dial or pointer, because the link adjusting screw is at the rear of the system.

Tubes built for millions of pressure pulsations

To fit the wide range of applications, Helicoid Bourdon tubes are available in four materials—alloy steel, K Monel, stainless steel and phosphor bronze.

All Helicoid tubes are made from seamless tubing and are carefully designed to give maximum torque and minimum stress. When used within the dial range, they will withstand many millions of pressure pulsations and will not stretch, leak or crack.

For complete information on the Helicoid line of gages write for **Catalog G-52**

Helicoid gives you all these features at prices that are competitive in the quality gage field.

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HAS BUILT OUR REPUTATION FOR BUILDING BETTER PIPE LINES

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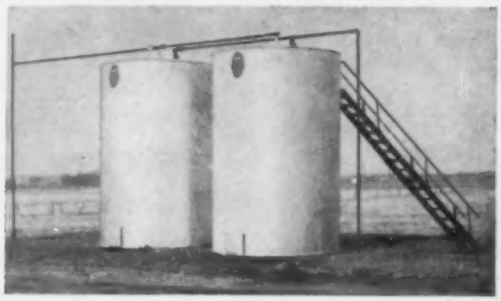
A WISE CHOICE



M&V Welded Lease STORAGE TANKS

M & V Tanks represent the most rigidly high standards of design, materials, and workmanship. Vapor tight without inspection or maintenance, they are outstandingly permanent and trouble-free.

Delivery and installation are fast and dependable. A complete stock is maintained. M & V Tanks are a wise choice!

MFD BY M&V TANK COMPANY — M & V — WICHITA FALLS, TEXAS

TREATERS — SEPARATORS — TANKS
Steel Fabrication for the Oil Industry

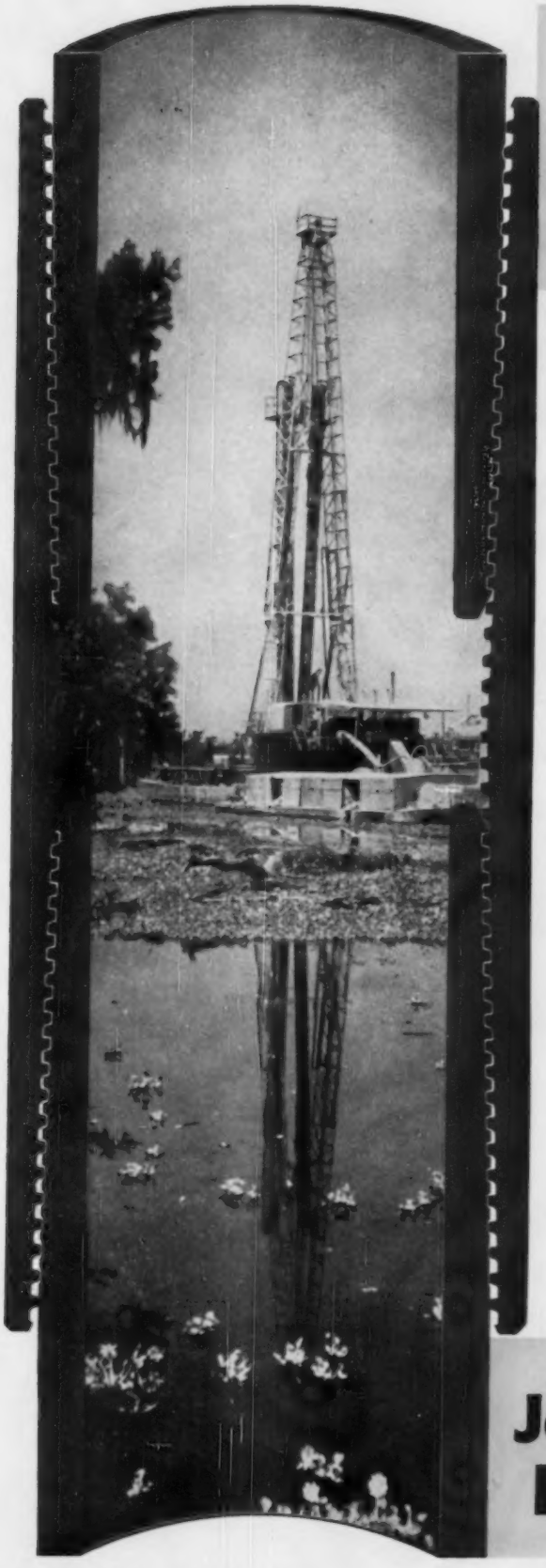
9-11	American Petroleum Institute, Division of Production, Mid-Continent district meeting, Biltmore Hotel, Oklahoma City.
13-18	American Chemical Society, national meeting, San Francisco.
15-17	University of Oklahoma, thirty-fourth annual gas measurement short course, North Campus, Norman, Okla.
16-18	Natural Gasoline Association of America, annual convention, Baker and Adolphus Hotels, Dallas.
17-18	American Institute of Mining, Metallurgical, and Petroleum Engineers, Louisiana-Arkansas, East Texas, and Mississippi petroleum sections, gas technology symposium, Shreveport, La.
20-23	American Institute of Chemical Engineers and Chemical Institute of Canada, chemical engineering division; Canada-U.S. chemical engineering conference, Montreal.
21-23	American Petroleum Institute, Division of Production, Rocky Mountain district meeting, Cosmopolitan Hotel, Denver.
27-29	Independent Petroleum Association of America, midyear meeting, Hotel Sherman, Chicago.
27-30	American Association of Petroleum Geologists, Rocky Mountain section, Casper, Wyo.
28-29	University of Oklahoma, third annual conference on automatic control in the petroleum and chemical industries, Oklahoma Memorial Union Building, Norman, Okla.
28-30	Southern Gas Association, annual convention, Dallas.

MAY

5-6	Society of Petroleum Engineers of A.I.M.E., North Texas section, secondary-recovery symposium, Wichita Falls, Tex.
5-7	Purdue University, thirteenth annual industrial waste conference, Purdue Memorial Union Building, Lafayette, Ind.
5-9	American Gas Association, distribution, production, and transmission conference, Roosevelt and Commodore Hotels, New York.
7-9	American Petroleum Institute, Division of Production, eastern district meeting, Deshler-Hilton Hotel, Columbus, Ohio.
12-14	Chemical Institute of Canada, National Research Council, eighth Canadian high polymer forum, Macdonald College, St. Anne de Bellevue, Quebec.
12-16	American Petroleum Institute, Division of Refining, midyear meeting, Statler Hotel, Los Angeles.
20-22	Pennsylvania Gas Association, annual meeting, Pocono Manor Inn, Pocono Manor, Pa.
21-23	American Petroleum Institute, Division of Marketing, midyear meeting, Roosevelt Hotel, New Orleans.
22-23	American Petroleum Institute, Division of Production, Pacific Coast district meeting, Biltmore Hotel, Los Angeles.
26-28	Chemical Institute of Canada, annual conference and exhibition, Royal York Hotel, Toronto.

JUNE

8-11	American Petroleum Institute, Division of Transportation, annual tanker conference, Greenbrier Hotel, White Sulphur Springs, W. Va.
19	Pennsylvania Grade Crude Oil Association, annual meeting, Penhills Club, Bradford, Pa.
23-25	Interstate Oil Compact Commission, midyear meeting, Hotel Utah, Salt Lake City.



Strong Joints for Long Strings

J&L BUTTRESS-THREAD CASING

J&L Buttress-Thread Casing joint is designed to support great weight.

The long coupling has completely engaged runout threads (five per inch) with ¾" taper per foot and a flank angle of three degrees. The Buttress-Thread, applied to non-upset casing, develops practically the full strength of the body of the pipe.

J&L Buttress-Thread stabs easily and makes up quickly — a time saver.

The product, as in the case of all J&L pipe, is of high quality by reason of mine-through-mill methods and controls of exceptional precision and care.

Available in seamless casing in grades J-55, N-80, P-110 and higher grades.

For further information consult your near-by J&L Supply store, sales office, or resident salesman.

Jones & Laughlin

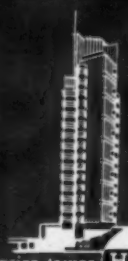
SUPPLY DIVISION – Tulsa

J&L – A GREAT NAME IN STEEL

(44)

Announcing: Development of the "Price-O-Matic Pipe-Welder"*. . . the pipeline construction industry's first fully automatic electric welding field unit . . . now in use on Trans-Canada's tremendous 34-inch diameter pipeline . . . completing perfect double-jointing welds in less than 7 minutes . . . in temperature extremes to 43 degrees below zero . . .

. . . another major contribution pioneered in the pipeline industry by . . . H. C. Price Co.**. . . pacing America's pipeline needs for more than a quarter century.



*patents pending

**and H. C. Price of Canada, Ltd.

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The OIL AND GAS JOURNAL

TULSA, OKLAHOMA

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JOURNALLY SPEAKING

Fundamental Research

DON'T READ THIS if you're looking for something funny. It started out as an attempt to treat a serious subject in a light vein, but the attempt fell flat on its face. (This is not the first time this has happended to us.)

Anyway, we were looking over the API papers on fundamental research. (Maybe you read some of them that took up many, many pages in the November 18 issue of our favorite oil publication.) The authors were trying to show how basic research in pure science, without much more definite purpose than to satisfy intellectual curiosity, has paid off time and again in money-making new processes and products for the oil business.

Now it was a curious coincidence (or did the API program makers plan it that way?) that just at that time the whole country was screaming about the Russian Sputnik and how we are so far behind in technological progress.

And our scientists were saying that the root of the trouble is that we haven't been putting enough emphasis on fundamental research. Oh, we'll support research projects that promise to turn a fast buck, or find some sort of answer to an immediate problem, or produce some tangible result in the form of a new gadget or gimmick. But it's fashionable to pooh-pooh long-haired inquiry in the basic whatness and whyness of things.

It was also a coincidence that there was a lot of talk about the oil industry's public relations — what's wrong with it and what can be done about it. The general opinion seemed to be that it is about as far behind the needs of the hour as the U. S. is in space travel.

So our nimble brain quickly put two and two together and generated this revolutionary thought: Why not do some fundamental research into how the oil industry conducts its relations with the public and why the public reacts the way it does?

This line of rumination called to mind a subject that has the advertising fraternity in a perfect frenzy at the moment—something called motivation research. As we get it, some long-haired psychological researcher has figured out that there are "hidden persuaders" deep down in a person's subconscious that make him think a certain thing, buy a certain product, or vote a certain way. Chances are the individual isn't aware of the real reasons why he does what he does.

If an advertiser can do enough motivation research to find out what makes people prefer Brand A over Brand B, he's got it made.

Now do you get our Big Idea? When some senator or editorial writer pops off with unfair digs at the oil industry, conduct some fundamental motivation research on him and find out the cause. After that, map out the cure.

Oh, we all may think we know the cause already. Also the cure. But it's obvious that the cures haven't always worked, so something must be wrong somewhere. It's situations like this that call for fundamental research.

An odd thing about fundamental research is that it sometimes turns up answers where you would least expect them.

For instance, it's conceivable that fundamental research into oil's public relations might possibly indicate that part of the trouble lies with the industry's actions rather than with the sort of press releases and advertising copy it puts out. Perhaps some oil men need to have their own hidden persuaders readjusted so they will act and talk in ways to please the public, instead of displeasing it as now appears to be the case.

The oil industry has had public-relations research. But most of it has been the one-shot, specific-project sort, not basic inquiries into the industry's actions and the public's reactions and the causes and cures of both.

If fundamental research has done so much for oil's technological progress, and if it promises so much for the nation's guided-missile progress, why wouldn't it be worth trying on oil's public-relations progress?

But, as we warned you at the outset, there's nothing humorous about this.

—Henry D. Ralph.

Controlled Fissuring Power!

Welex BEAR GUN

(FORMATION FRACTURING TOOL)

The gun that shoots 'round a corner!

Welex called this mighty innovation the Formation Fracturing Tool when they developed and introduced it two years ago — you, in the field, gave it a new name after using it — the Bear Gun. By any name — oil operators everywhere are calling more and more for the tool's great fissuring power in their tough wells. Wherever the formation or a heavy invasion of mud or cement hinder the flow, call Welex for the Bear Gun. Each shot will give you a large entrance hole — deep into the formation — and the extensive fissuring that reduces pressures and makes your fracturing job a success!

Perforating is no sideline with WELEX!

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What pipeline divorcement would mean to producers

INDEPENDENT oil producers are sore at pipelines because they don't have the lease connections and market outlets they desire.

In their pique they may become dupes of scheming reformers who for years have been agitating disintegration of the oil industry and divorcement of crude lines from major-company ownership.

The most recent congressional blast espouses the theory that divorcement would give independents a broader and more competitive market. Before producers swallow that, they should take a look at what sort of markets and connections they would have if crude lines were independent.

OF SMALL IMPORTANCE to a producer is the legal status of a crude carrier. What he wants is a steady purchaser who will take his full allowable day by day on a long-time basis.

A major company can provide such a market through the hand-in-glove operation of its pipeline and crude-oil departments. It has the necessary flexibility because of its storage facilities, diversity of outlets (including independent refineries), and crude-trading activities.

In normal times a major will lay a line to a new field to buy an independent's oil because it wants to control the crude, and particularly if it wants to hasten development of its own acreage in the area.

In these abnormal times few such connections are being made. But does anyone really think that more such connections would be laid by an independent pipeline carrier with no financial stake in the crude it carries, in future supplies for refineries, or in developing new production?

Even in normal times an independent crude line would have to operate like a gas line. It could not finance a line to a new field until sufficient reserves are proved to guarantee amortization, nor without a long-term market commitment.

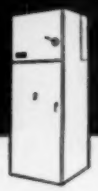
Scattered driblets of production—say 100 bbl. per day—would not interest an independent refiner (and all refineries would be independent under divorcement). So middlemen would have to assume the functions of collecting, marketing, and arranging transportation for independent producers. This would be more expensive and less effective than the present system.

Bankers won't finance producing operations unless there is an assured market for the crude. Today the overwhelming majority of independents have this. Under divorcement very few would.

SOME IMPROVEMENTS may be needed in the crude-buying system. There may or may not be other arguments for disintegration.

But it makes no sense to assert that independent producers would be better off than they now are if crude lines were divorced from all interest in field development, refinery supply, and ownership of crude.

Newly designed
Type H Motor Control



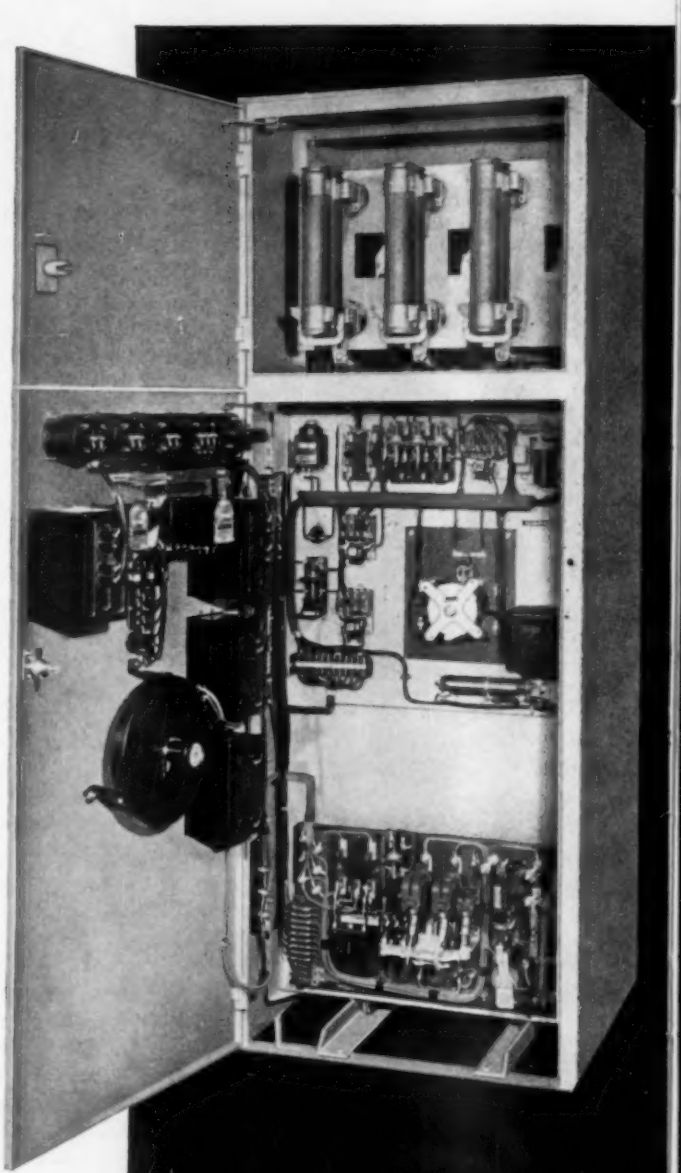
More room for optional features

Now, with Allis-Chalmers high voltage control, you get more panel space for additional components.

Meters, pushbuttons, instruments, rheostats, indicating lights, relays, and other components can be installed—thanks to the ample space available on both the outer door and inner barrier.

Along with more room, this new A-C design is front accessible, has smaller cabinet size, provides ultimate in protection for men and machines, and has been completely tested.

For more information on this engineering advance, contact your A-C office or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.



All this area on Allis-Chalmers new Type H motor control is available for optional features. In many applications, this extra space eliminates the need for an extra cabinet.

Removable panel, on which control devices are assembled, is mounted on inner barrier. Entire panel may be quickly removed for inspection and maintenance.

ALLIS-CHALMERS

A-5519

the OIL AND GAS JOURNAL

December 2, 1957

Early LPG Flood Runs Into Trouble

Sun's experience in Millican field indicates it may be tough to control miscible-phase recovery projects outside the laboratory. Preliminary analysis: Not enough propane was injected.

MISCIBLE-PHASE displacement, regarded generally by the industry as a highly promising new oil-recovery tool, may prove a difficult one to use.

This may especially be true of the LPG-slug method, which calls for injection of a calculated volume of propane or butane, followed by injection of dry gas. This method is currently the most popular approach to LPG floods.

Evidence that operators may find it extremely touchy to maintain such a drive already is emerging from a Texas pilot project.

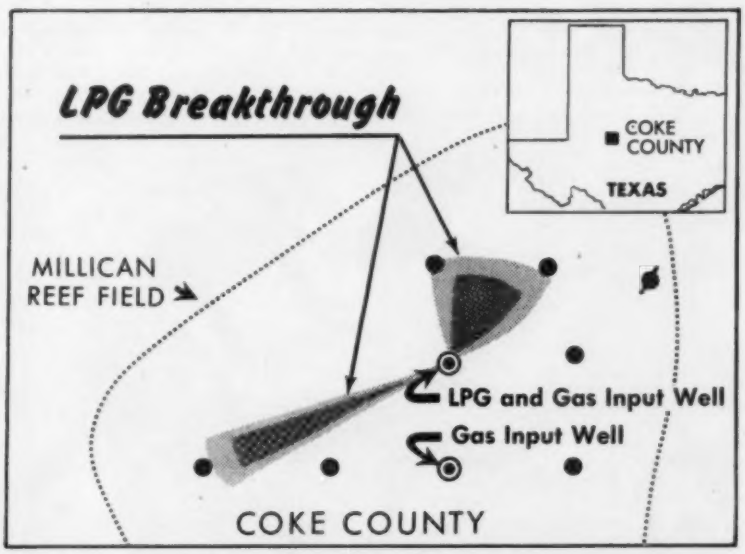
This is Sun Oil Co.'s operation in Millican Reef field of Coke County, West Central Texas. Sun launched a pilot test of the LPG-slug technique in the northern nose of the field in the summer of 1956 (O&GJ, Mar. 11, 1957, p. 98).

Millican has 37 wells on 1,480 acres and is wholly owned by Sun. It produces from the Strawn reef at about 6,000 ft. The company prior to summer 1956 had been carrying out a conventional gas-injection program in the field.

Sun finished injecting 600,000 gal. of propane-butane mix—85 per cent propane—through one input well in September 1956 and began injecting 2,500 M.c.f. of gas daily through the same well (see map). To help isolate the pilot, another 3,500 M.c.f. was injected daily through one of two original gas input wells a location to the south. Conventional gas injection was continued over the rest of the field.

Early last year Sun began to see evidence that a fluid or miscible front had formed. Gas-oil ratios began to fall. Oil production was stepped up as high ratio penalties were removed. The project appeared to be clicking. This summer, however, the G.O.R. trend suddenly switched and ratios began to climb again, indicating that the drive had reverted to two-phase flow. Final evidence of breakthrough came when Sun detected traces of propane in produced oil from three of the observation producing wells.

The miscible front apparently lasted for about 4 to 6 months.



PROPANE is showing up in three producing wells in pilot project. Sun figures its miscible-phase front was maintained only 4 to 6 months.

Why the breakthrough . . . Sun engineers now have had time to make a preliminary study of why the miscible front dissipated so soon.

This is a hard thing to pin down. As one engineer said, "The only time you can be sure what is going on in such a project is when it works. If it doesn't perform well, there are usually several different explanations available as to why not—most of them logical."

The evidence at Millican, however, leads Sun engineers to believe that not enough propane was injected.

Laboratory work by several companies generally shows the desired amount of LPG for injection at about 2 to 3 per cent hydrocarbon pore space of the reservoir area to be swept. This was the volume injected in the Sun pilot, but company engineers calculate only 15 to 20 per cent of the pilot reservoir volume was swept prior to breakthrough.

The pilot results and the preliminary study of evidence suggest to Sun engineers that the LPG requirement for Millican's Strawn reef pay might possibly run as high as 10 to 15 per cent of hydrocarbon pore space.

Too, engineers feel a contributing factor was the relatively high gas saturation in place in the Strawn. The pilot likely would have performed better if it had been possible to start it several years back when gas saturation was lower.

What now? . . . Despite the early de-

mise of the miscible front in the Millican pilot, Sun may have recovered enough added oil to make the project pay.

Whether the pilot paid out is an intangible Sun likely will never be able to resolve. The extra oil recovered was enough to pay out cost of the pilot. But the company might have produced some of this oil in future years without the pilot.

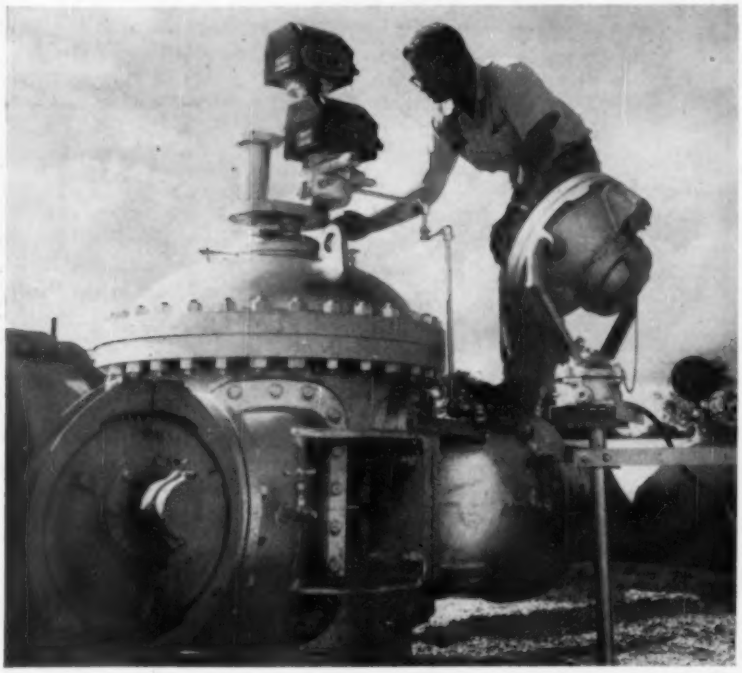
Further study of the pilot results are currently under way. Sun hasn't yet abandoned the idea of expanding the miscible project throughout rest of the field. Such an expansion was initially in the cards if the pilot performed well.

The key question is whether a field-wide operation, even if it performed ideally, would prove economic in light of the need for a lot more propane.

Results important . . . Results of the Sun experiment are of unusual interest in that they come from one of the first LPG-slug projects.

It's impossible, however, to judge the chances of success or failure of others of its type. No two reservoirs are identical. Moreover, the Sun pilot involved a reef-type formation. Such pays generally are more unpredictable and harder to figure than sands or limestones.

But the project may serve notice that operating a miscible drive of the LPG-slug type will be no snap—that it likely will require extreme care in choice of reservoir and unusually precise design and control of operations.



Giant Pipeline Meter Passes Year's Test

ONE OF THE WORLD'S LARGEST positive-displacement meters for measuring crude delivered by pipeline has checked out successfully over a year's testing.

Testing proved the meter:

. . . Was accurate to within one-tenth of one per cent. This is the requirement for all meters used in transferring petroleum products.

. . . Could click off 10,000 bbl. of oil an hour. Until now the largest meter of this kind has been able to handle only one-quarter of that capacity.

During the year-long test, conducted in Louisiana by Interstate Oil Pipe Line Co., the meter handled more than 60 million barrels of oil.

Working part of the meter is a rotary mechanism with metal vanes dividing the oil into components of prescribed volumes. Each revolution of the mechanism equals 1 barrel.

Development of the meter was carried out jointly by Esso Research & Engineering Co. and Interstate Oil Pipe Line, both affiliates of Standard Oil Co. (N. J.), and the A. O. Smith Corp. of Los Angeles.

UOP Hearings End

but stock sale is still long way off. Referee will act after January 4.

SALE OF UNIVERSAL Oil Products Co., Inc., stock moved a short step nearer realization last week.

Guaranty Trust Co. summed up its justification for the sale and its compensation of 10 per cent of the proceeds, thus ending hearings which have been under way in New York since October 29 before Referee Louis M. Loeb.

The referee set December 18 as the last day for filing supplementary briefs and January 4 as the last day for replies to briefs. After that he will submit his recommendation to Judge Jacob Markowitz of the New York State Supreme Court.

Theodore Kiendl, representing Guaranty, justified the compensation sought on the basis of the very great services Guaranty performed as trustee. He credited these efforts with building Universal's net worth from something less than $3,000,000 in 1944 to $23,000,000 in 1957.

He said the firm's total worth today was in the neighborhood of $50,000,000, a far cry from a company that was on the verge of insolvency in 1944.

Assistant Attorney General P. Hodges Combier said that the attorney general did not object to the sale but did object to the compensation.

He contended that Guaranty had taken over the trust as a favor to the five major oil companies who had donated their holdings in UOP to the Petroleum Research Fund.

He pointed out that since Guaranty had taken over as trustee it had increased loans to oil companies from a relatively small amount to a current total of $300,000,000. Interest on these loans, he contended, is more than ample compensation.

Record Oklahoma Test Dry

MAGNOLIA PETROLEUM CO. was ready to abandon Oklahoma's deepest hole last week. The 1 Sterba-Ordovician in Caddo County was waiting on abandonment after several weeks of testing Springer sands up the hole.

Magnolia and its partners took the hole to 20,426 ft. in September in search of Bromide Ordovician sands in Cement field. At that time, some sources reported the well would go to 24,000 ft., which would have been

deeper than the world's deepest. But Magnolia announced drilling would be halted.

With total depth in the Sycamore, the well was plugged back to test Springer sands at 14,008, 14,310, and 14,415 ft., but the tests reportedly came up with noncommercial shows of gas.

Record Gas Mark

will be set for southern California in December.

SOUTHERN CALIFORNIA'S imports of Texas and New Mexico natural gas will top 1 billion cubic feet daily this month.

Completion of a compressor station at Needles, Calif., will boost imports of Southern California Gas Co. and Southern Counties Gas Co. by 227 million cubic feet daily. Present capacity is 800 million.

Initially, the new compressor station will operate with four 2,000 hp. turbocharged compressors. A fifth will be added next year and two more in 1960.

The two southern California gas utilities recently completed a 285-mile, 30-in. line from Needles to Los Angeles. They also operate two 30-in. gas lines to Los Angeles which originate at Blythe, 95 miles down the Colorado River from Needles.

With the addition of the new line and compressor station, about 75 per cent of the natural gas used in southern California will come from the San Juan and Permian basins in New Mexico and Texas. For the past 10 years gas imports into the state have increased each year at the rate of 100,000 cu. ft. daily.

Delta Pipeline Plans Made

SHELL PIPE LINE CORP.'S proposed Delta pipeline will have an initial capacity of 70,000 bbl. daily, it was announced last week.

The 118.5-mile line will move crude oil from the Southwest Pass area of coastal Louisiana to Shell Oil Co.'s Norco, La., refinery.

Shell Pipe Line has opened a New Orleans office to supervise construction of the line. The office will be headed by R. V. Lahr, field manager for the new project.

Preliminary plans for the pipeline were announced by Shell Pipe Line last month (OGJ, Oct. 14, p. 107).

The line will consist of 11 miles of 8-in. pipe, 11 miles of 12-in., 36.5 miles of 16-in., and 60 miles of 20-in.

Oklahoma-St. Louis Gas Line

. . . is planned by two new companies. Promoters offering from 2½ to 4 cents above going price for Oklahoma gas.

THE ST. LOUIS MARKET, where coal and fuel oil have held their own with natural gas, has long been considered ripe for further exploitation by natural gas.

A step in this direction is being taken by two companies which are buying reserves in Oklahoma. They propose to build a pipeline to St. Louis to get a piece of the gas market now held entirely by Mississippi River Fuel Corp., which built a line from Louisiana almost 30 years ago.

A tentative proposal for a 425-mile, 16-in. line from the Oklahoma City area to St. Louis has been laid before the Federal Power Commission by Mookl Chemical & Gas Corp., Tulsa, and Missouri Transmission Corp., Springfield, Mo.

This was not a formal application supported by rates, cost studies, and reserves under contract. However, the companies say they expect to firm up their plans before the commission around the first of the year. Fish Engineering Corp., Houston, has been retained to do preliminary engineering and cost studies. DeGolyer & MacNaughton, Dallas, is preparing reserve estimates.

Mookl reports it has firm contracts for gas in Pottawatomie and Okmulgee counties, in eastern Oklahoma. Uncommitted reserves in this immediate area are not considered adequate to support a project of the size proposed by Mookl and Missouri. But the companies have declared their intention to go as far as Stephens County, in southwestern Oklahoma, in search of reserves.

Mookl is reported to be offering 12½ to 14 cents per M.c.f. as a starting price, or 2½ to 4 cents above the generally accepted going price in the area.

Promoters of the line are Victor J. Hermel, Tulsa, president of Mookl; Eugene Williams, Springfield, president of Missouri Transmission; G. E. Cannon, Tulsa; and Harry J. Peterson, Minneapolis, former Minnesota Supreme Court justice.

Line plans . . . Mookl would build a 170-mile line to the Missouri border in Delaware County, Oklahoma. Missouri Transmission would build the Missouri section.

The companies propose to start operating with throughput of 100,000,000 cu. ft. daily. They hope to raise volume to 300,000,000. Some 800 billion cubic feet of reserves would be required initially.

Customers would be Laclede Gas Co., the St. Louis distribution company, or industries which would buy direct from the transmission firms.

Barge Hauls Butadiene to Italy

A BARGE loaded with 830,000 gal. of butadiene is on the high seas this week bound for Ravenna, Italy, from Port Neches, Tex.

Goodrich Gulf Chemical Co. furnished the butadiene, and Warren Petroleum Corp. is transporting it on a new barge built by Bethlehem Steel Co.'s shipbuilding division at Beaumont, Tex.

At Ravenna, a synthetic rubber plant is now under construction, and presumably the butadiene will be used as a stop-gap supply until a Houdry dehydrogenation process unit is built.

The plant is a project of ANIC, subsidiary of Ente Nazionale Indrocarburi (ENI), the Italian government's oil development agency.

Houdry Process Corp. says licensing agreements have been made to build the Houdry unit, which will have a nominal design capacity of approximately 20,000 short tons of butadiene annually. The unit is the eighth built by Houdry since World War II.

Engineering of the unit is under way at Houdry in Philadelphia, but construction will be at Ravenna, where ANIC is building its plant for synthetic rubber and nitrogen fertilizers.

Presumably ANIC will make butadiene from butylene and butane from Po Valley gas fields.

The butadiene shipment, first of its kind to Italy, left Port Neches by barge November 21 and is due to arrive at Ravenna December 20-25.

The new Warren barge, Puerto La Cruz, has an 893,000-gal. water capacity and was built to transport LPG, anhydrous ammonia, and other chemicals.

It was loaded at the docks of Neches Butane Products Co. at Port Neches. Towing the barge on the long haul is a 2,000 hp. sea-going diesel tug.

California Producers' Stark Fox leads off at hearing where . . .

Fight Opens for West Coast Controls

- **Washington testimony reveals this lineup on curbs for District 5: Producers favor restrictions, all importers except Union hotly oppose any limitations.**

- **Two courses laid before Carson: Flat quotas for West Coast or quotas based on nation-wide allocations.**

DOMESTIC OIL PRODUCERS are making a strong fight for extending import controls to the West Coast.

First step came last week in a 2-day hearing before Capt. M. V. Carson, Jr., program administrator.

Spokesmen for a long list of producer groups joined in condemning unrestrained imports for the West. They claimed steadily rising imports threaten to throttle exploration and development in District 5.

Witnesses generally reported imports on the West Coast already are exceeding the 296,000 bbl. daily which the importers set last July in reports to the cabinet committee.

West Coast importers, however, took the position that curbs are not desirable. Only Union Oil Co. of California agreed that cargoes are excessive and will continue so.

New schedules just filed with Carson by 18 importers show receipts during the first 6 months of 1958 will average 348,880 bbl. daily (see table).

The solution . . . Two courses for controlling the import flood were laid before Carson:

. . . Flat allocation of 173,000 bbl. daily.

This was advanced by Stark Fox, executive vice president of the Oil Producers Agency of California. He said that figure represents the difference between domestic demand and the amount of domestic oil available to the region.

. . . Combine the West Coast with other districts now in the voluntary program and make the area share in nation-wide quotas.

Groups holding this position testified that exemption of District 5 on the ground it is a deficit area is not tenable. They pointed out the East Coast also is a deficit area. There is no reason why any area should be treated differently.

Extension of controls to the West Coast would open up a big question, Carson told the producers.

Some companies import on both the East Coast and the West Coast, he said. The question then would be whether to give them separate quotas for each coast or an over-all quota. The latter might permit them to switch imports from one coast to the other as conditions required.

Demand outlook . . . A switch from oil to natural gas by West Coast utilities is taking the pressure off demand for residual, Carson was told at the opening of the hearings by Donald S. Colby, petroleum economics chief of the Bureau of Mines.

Demand for gasoline and distillate fuels is rising, however, he said.

Colby placed demand for all products at 1,330,000 bbl. daily during the coming first quarter. That would be 1.6 per cent under the same quarter this year. But demand in the second quarter at 1,230,000 bbl. daily, will be 0.2 per cent over 1957.

These figures were supplemented by William R. Wardner, Jr., general manager of the Conservation Committee of California Oil Producers.

The state's output in the first quar-

ter of 1958 will be 932,000 bbl. daily, Wardner estimated. Second-quarter production will be 926,000 bbl. daily.

There is no reserve capacity in the state, Wardner testified. On the contrary, production now is running about 12,000 bbl. daily above committee recommendations.

Fox's plea . . . The 173,000-bbl. limit proposed by Fox is based on estimates that 1,114,000 bbl. of crude or natural-gas liquids is available on the West Coast while the dai y demand is 1,287,000 bbl.

Fox estimates daily crude production in District 5 is 929,000 bbl. while 80,000 bbl. of natural-gas liquids is available along with 70,000 bbl. of product receipts and 35,000 bbl. of crude pipelined into the district.

Against this, Fox said domestic civilian demand will be 1,102,000 bbl. daily. Offshore demand will be 75,000 bbl., and military takings will be 110,000 bbl.—a total of 1,287,000 bbl. daily.

Present import levels leave a substantial excess over demand, Fox said. Stocks at the end of this year will total 142,340,000 bbl., he estimated. That's the highest since December 1940.

As imports increase, well completions, drilling, and exploration fall off, Fox declared. This will preclude the development of additional reserves.

A common policy . . . The idea of bringing the West Coast into the voluntary program was advanced by Leonard R. Seaman, president of the San Joaquin Valley Oil Producers Association.

If District 5 continues in its present status, Seaman said, it would be "naive" to suppose that California operators who have found new, big production in Venezuela will withhold imports simply because other importers are already flooding the market.

Independent producers from Texas, Oklahoma, Louisiana, and New Mexico joined in Seaman's argument.

Crude line backed . . . Import control would make the proposed Texas-California crude pipeline feasible, John Davenport, general counsel of Texas Independent Producers and Royalty Owners Association, said. He charged the line now is being b'ocked by West Coast importers.

The proposed 30-in. line would link California with a four-state area where Texas alone has excess producing capacity of more than a million barrels daily. This would give the West Coast protection in the event of war, Davenport declared.

An importer talks . . . David E. Day, vice president of Richfield Oil Corp., contended at the hearing the West Coast should continue to be exempt from controls.

He cited three important differences in District 5 conditions that make this necessary:

. . . California production is not sufficient to meet demands of the district.

. . . Drilling activities in California have not been curtailed because of imports.

. . . Selling practices of California producers are different. They usually sell oil under term contracts rather than division order as elsewhere. This means that virtually all California production is committed to refiners, usually on long-term basis.

Day testified that an integrated company in California must include imports in any expansion plans it makes. He said Richfield has been an importer since 1954 but never has terminated a contract for California crude nor has it declined to renew any expired contracts.

Union Oil backs producers . . . Strongest company support for the producers came from Charles F. Parker, vice president of Union Oil Co. of California.

"Oil imports on the West Coast have been greatly in excess of quantities needed to supplement domestic supply," Parker said. "In our estimate, planned imports for the next several months, as recently announced, would continue to be excessive.

"Such excesses will discourage domestic exploration, development, and production of petroleum. Under such conditions, it will be increasingly difficult and perhaps even impossible to maintain our domestic productive capacity at levels essential to our national security."

The other side . . . In sharp disagreement with Parker, D. T. Staples, president of Tidewater Oil Co., held in a brief filed with Carson that imports "are not in any way endangering national security."

"The effect of any steps taken by the Government to restrict such imports would be to reduce supplies in relation to demand, creating an upward pressure on West Coast petroleum prices, to the detriment of consumers," Staples asserted.

"Such a result would expose the Government to the charge that such steps were taken solely for that purpose—a purpose not authorized by the governing statutes."

Curbs also were opposed by General Petroleum Corp., whose director in charge of oil supply, Arnold D. Bennison, assured Carson that present excess stocks are only temporary. The condition was created by increased natural-gas imports and the impending crude supply from Four Corners, he explained.

The same view was taken by T. S. Petersen, president of Standard Oil Co. of California in a letter to Carson.

The West Coast will have to figure on imports for some time to come, Petersen wrote. But eventually domestic production from Four Corners and other areas will make imports less necessary.

A new pipeline . . . A Texas-California crude pipeline offers the logical solution to the problem, it was asserted by Charles S. Murphy, counsel for West Coast Pipeline Co.

Murphy said private financing for the line cannot be had "because the importing oil companies on the West Coast have refused to agree to take any of the oil."

"We have the paradoxical situation where the West Coast importers are excused from the import program simply because they refuse to commit themselves to take this domestic oil," Murphy charged.

"The Government has at hand the means to break this vicious circle." Murphy contended that if District 5 is put under control it will "almost double" the effectiveness of the program in encouraging exploration and development. Also, he said, it would serve an important national defense purpose, giving the West Coast domestic crude supplies needed in war.

Planned West Coast Imports

Importers on the West Coast announce they plan these average daily imports for the first 6 months to 1958:

	Bbl. daily
Caminol Co.	7,500
Douglas Oil Co.	4,700
Edgington Oil Refineries, Inc.	3,000
Fletcher Oil Co.	5,700
General Petroleum Corp.	27,400
Hancock Oil Co.	3,600
Mohawk Petroleum Corp.	3,800
Richfield Oil Corp.	26,900
Shell Oil Co.	35,000
Sunland Refining Corp.	2,500
Superior Oil Co.	35,000
Texas Co.	28,500
Tidewater Oil Co.	51,000
Union Oil Co. of Calif.	14,000
U. S. Oil & Refining Co.	11,700
Wilshire Oil Co.	30,800
Standard of California	55,200
Macmillan Petroleum Corp.	2,500
Total	**348,800**

Sunray Plans to Grow Its Own Bosses

● Manpower upgrading is the ambitious goal of a company-wide program. Its purpose: Increase the ability of every employe and also create a replacement pool for key jobs. The reason: These days it's better—and cheaper—to develop managers from within.

Bill Bachman
Tulsa District Editor

SUNRAY MID-CONTINENT OIL CO. had to take a new approach to this grow-your-own concept for training its workers and developing management talent.

The reason is this: Sunray became an integrated oil company nearly overnight. It didn't have the time advantage of some majors who have built up elaborate programs over several years. And it didn't want to approach the problem by any hit-or-miss method.

So Sunray followed this track: Management took a look at its entire manpower problem and charted a long-range training and development program almost from scratch.

The problems faced by Sunray executives and their experiences could be a guide to other medium-sized or even smaller companies faced with the same situation.

Why the change? . . . Two conditions actually alerted Sunray executives to action. These were:

. . . Remarkable growth of the company. A merger of the old Sunray and Mid-Continent companies resulted in a much larger integrated firm with activities vastly expanded over those formerly carried on by the separate companies.

As one official put it: "Three years ago the company was much smaller. A development program could be run on an informal year-to-year basis. Now with 6,000 employes, we must formalize the program and put it to work."

. . . Technological progress. Equipment and methods become outdated more quickly now. Employes must be kept up-to-date on new techniques.

This is explained fully by I. H. Hughes, vice president and assistant to the president of Sunray. He says:

"It is impossible in these progressive times for a person to perform the same type of work for any length of time without being confronted with change. Methods change. New equipment is brought into use. New functions are created.

"Employes must keep up with the changes. And the only way to accomplish this is to continue to learn more about the job and the tools used in the work."

The approach . . . Sunray employed an outside specialist to join the company staff and help management design the program.

Everett Smith, picked for the job, had previous experience in oil-company training work with Shell Oil Co. After a year's research, Smith and other Sunray executives outlined a broad program. It included:

. . . Management development. This covered department managers and all supervisory personnel. Idea is to spot potential future managers, evaluate their abilities, and create a training program to strengthen any of their deficiencies.

. . . Technical development. Engineers, chemists, process experts, and other technical specialists need to be kept abreast of progress in their particular lines.

. . . On-the-job training. Craftsmen, operators, mechanics, etc., need to be trained in operating and maintaining new equipment or processes.

. . . Supervisory development. Part of this program has been in effect at Sunray for several years. It aims to give supervisors training in how to get along with people, how to give orders, how to relay management policies to employes under them. It is to be continued and expanded.

. . . Orientation training. New employes in every category need to get the whole picture of the oil industry, of Sunray's operations, and how their new jobs relate to the whole.

New concept of management responsibility toward stockholders is presented by Everett Smith, training director for Sunray Mid-Continent Oil Co.

Besides its other duties, modern oil-company management must keep an adequate supply of personnel trained for today and the future, he contends.

Smith has spent more than a year with Sunray doing research on several types of development programs and studying projects already under way in the company.

The result of his work is the formal company-wide management-development and technical-training plan finally adopted by Sunray officials.

Before joining Sunray, Smith served as training representative with Shell Oil Co. in New York.

Sunray's Approach to It's Training Program...

STEP 1 Outline objectives to provide: A No. 2 man trained to take over every staff job, an up-to-date inventory of supervisory talent, a climate which affords potential managers a challenge and chance to develop themselves, and a new way to pick, train, appraise, and place key men on company-wide basis.

STEP 2 Fix scope of program so that management personnel embraces everyone from first-line supervisors through corporate officers.

STEP 3 Draw up a 5-point plan to make the program work.

STEP 4 Create administrative machinery with a management-development committee having over-all direction of the program. Each department manager is made responsible for developing management personnel under him. Employee relations department is responsible for technical direction and coordination of program.

5-POINT PLAN

1. Make an organization chart of present jobs and of new jobs which company growth will demand. Coupled with a job description manual, this chart is the guide for developing men to fill posts.
2. Inventory personnel to supply data for a replacement chart and to give a graphic analysis of each department's present strength. It lists best prospects for leadership and shows where replacements for every job will come from.
3. Appraise each individual's performance in his present job and evaluate his potential ability. This is done once each year by three-man committees.
4. Prepare a development schedule outlining what each individual needs to gain greater proficiency in his present job and prepare for a better position.
5. Review management development program annually.

Sunray in the past has taken many steps to train employes. A sales-training school has been operating for 10 years. It was started by the former Mid-Continent company and continued after the merger. In addition several departments have offered training projects for technical people, such as geologists, engineers, draftsmen, etc. Many on-the-job classes have been held on new equipment and practices. Most of these activities will be continued. Others will be added, and all will be worked into a coordinated program.

Future managers . . . The company decided its future growth might well be hampered if a shortage of trained management should develop.

For that reason it moved the management-development project out of the planning stage first and got it under way. Preceding that, however, Smith and company executives carefully outlined their procedure (see box).

The plan was simple: Draw up the objectives, determine who will be included in the program, outline the steps needed, and set up the machinery to carry it out.

Knowing the objectives is important. This may be the key to successfully launching a management-development program. A climate must be created which will afford potential managers a challenge to better themselves.

The whole program may fall flat if the employes don't buy it. Cooperative efforts from potential managers are vital. These men have to want to make things better for themselves and the company or the developing program is a failure.

For this reason Sunray officials took care that the basic objectives and company motives in advancing the program were clearly understood and explained fully to all.

The appraisal . . . Most ticklish part of the five-step plan adopted by Sunray is the appraisal of management talent.

This is easily understandable. Previously the company analyzed its expected manpower needs and then took a physical inventory of the jobs. But when it comes to determining how these present workers stack up for their present jobs or future work, any evaluator is on touchy ground.

Experts often have warned that unless job evaluations are carefully handled they can do more harm than good. The task of analyzing a worker's thinking, personality, and ambitions can be complex. A mistake can be disastrous to morale.

Sunray moved cautiously on this score. The appraisal machinery consisted of a three-man management-development committee. It included the person's supervisor plus two other members of management higher than the individual being considered.

These men had before them special appraisal forms and a personal history and experience record of the man. The supervisor beforehand completed an appraisal of the individual's performance. Such matters were considered as the quantity and quality of the man's work, his knowledge of the job, initiative and industriousness, judgment and analytical ability, ability to work with other people, and his ability as a leader, coordinator, and organizer. The committee went over the appraisal and then evaluated the worker's potential—whether he is ready for a higher job or how soon he can be prepared.

The completed appraisals were reviewed by higher management. After this, the immediate supervisor must follow through. He will hold a confidential talk with the worker, discussing his present performance, his merits, and ways to improve. The evaluation of the man's potential ability, however, is never discussed with him.

The development . . . When these preliminaries are out of the way, each Sunray department head prepares a development schedule for managerial personnel under him.

The schedule represents a program of training and experience designed to fit the observations and recommendations of the appraisers. These are revised by the management development committee which made the original appraisals.

Many avenues have been created to develop potential managers. They include on-the-job training, personal counseling, company-training courses, committee assignments, training po-

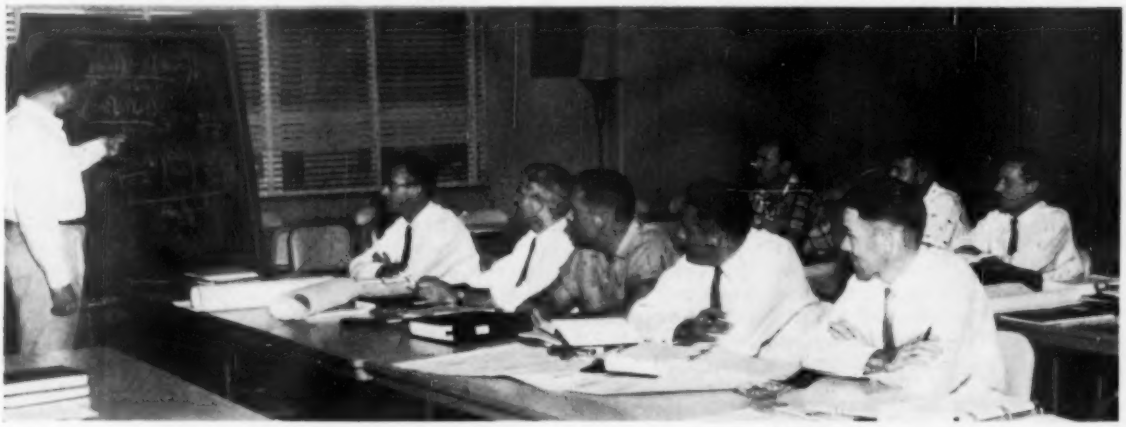
The heart of Sunray's new development program: Make everyone from top to bottom feel it pays dividends to grow with the company.

Actually it's a teaching job, as these photographs show. Men must be trained in new ideas, methods, tools.

Their bosses also must learn how to oversee this training and interpret results to top management.

From this process will come Sunray's future executives.

Shop and field men are trained to do jobs better.



Engineers are constantly being brought up to date on new methods and tools in all phases of the oil industry.

Top supervisors attend classes to keep abreast of newest training ideas so they can better handle their jobs.

sitions, job rotation, periodic management conferences, management courses, special seminars, evening courses, or professional society work.

Through the development program, Sunray hopes to have at least one replacement trained for each management position and other managers ready when the time comes to expand.

But Sunray executives are realists. They don't claim their program is revolutionary—or exactly new. Their approach is unusual. It attempts to be frank and fair and is based on one idea: Convince all Sunray people it will be worthwhile to grow with the company.

Gulf States Unite

for common fight to hold tidelands. But they plan separate strategy too.

THE FIVE STATES along the Gulf Coast will present separate arguments to the U. S. Supreme Court in support of their tidelands claims.

This strategy was announced following a meeting in New Orleans of legal representatives of Texas, Louisiana, Mississippi, Alabama, and Florida.

Louisiana Atty. Gen. Jack P. F. Gremillion revealed, however, that the states had agreed on a "common defense" against the federal Government's boundary claims. The Justice Department suit originally singled out Louisiana and sought to have the state boundary set at 3 miles from shore.

The suit recently was extended to determine the seaward boundaries of other gulf states. The states have until January 2 to file answers with the Supreme Court.

Under the Justice Department's interpretation of the Submerged Lands Act of 1953, seaward boundaries of gulf states would be 3 miles from shore. The states are united in opposing this interpretation.

Separate answers will be filed since the coastal states claim various seaward limits and base their cases on different arguments. Under the Submerged Lands Act the states bordering the Gulf of Mexico were given title to the tidelands as far out as their "historic" boundaries, but not more than 3 leagues seaward.

Texans riled . . . The Texas house, meanwhile, asked the President to prevent any federal legal action challenging Texas' 3-league offshore boundary.

It passed a resolution saying people of the state are "shocked, surprised, and disilllusioned" at the federal action.

The resolution urged the President order the solicitor general not to take any position against Texas which would challenge the latter's present 3-league boundary. The house took action on the strong urging of Gov. Price Daniel, who was instrumental, as a U. S. senator, in passing the present tidelands act.

"If the agreements of this nation and the words of our federal officials are worth the paper they are written on, no lawsuit should have been filed against us," the Texas governor said.

watching WASHINGTON

. . . with Bertram F. Linz

Key to foreign trade policy

DOMESTIC OIL PRODUCERS already are talking about the line to be followed when Congress takes up extension of the Trade Agreements Act next year.

They are, on the whole, pleased with the effort now being made to control imports. But some are a little suspicious. They fear that the administration's concern may be due largely to its desire to have its foreign trade policy reapproved by Congress.

The big aim will be to see that safeguards against any relaxation of the import program are written into the law.

The national security clause, on which the program is based, was accepted by Eisenhower as the only apparent alternative to quotas. Officials have made it clear that if the importers do not cooperate, forced quotas of some sort are all that is left.

With the administration in danger of having to go to quotas after all, some producers look for suggestions from the White House which would take the President off the hook. Any such step will be bitterly fought.

Oil may well be the issue on which extension of the act stands or falls. Other industries will strongly oppose it. The weight of the far-flung domestic oil industry could be the decisive factor.

Oil and radioactive fallout

A NEW FACTOR has greatly complicated the job of planning for recovery from an enemy attack.

It's the radioactive fallout which could follow atomic bombing. The U. S. is trying to make a "clean" bomb, with little fallout. But an attacker might not be so humane and might use fallout as a weapon.

Here's what top government officials see in that event. Bomb damage would be local. But radioactive dust could be carried by the winds to other areas, leaving an uncontaminated zone between them. The country would be split into undamaged areas of varying sizes and shapes, separated from one another.

Thus, transportation between unaffected areas would become the big problem. There might be a lot of oil in one place and a vital need for it in another. The contamination might last for weeks or months.

Localities sitting right on pipelines would be all right. But outward movement from the pipeline might be limited to a few miles, even though highways and railroads were themselves undamaged.

One thing is certain. The Government would have to take over all forms of transportation. But it is admitted that in an immediate post-attack period national direction would not be possible. Until this could be done it would be up to the oil industry and the railroads to keep supply lines going.

Tough sledding for small business

SMALL BUSINESSMEN are finding out that there are headaches as well as profits in doing business with the Government.

Government contracts are fine as long as we have a free-wheeling economy. But when things get tight the headaches set in.

Independent refiners learned this last August. The Defense Department cut back its oil contracts by well over $100 million. The big companies could take this in their stride. The small ones found themselves with needed money tied up in products they couldn't move.

Here's another instance: One of the small contractors taking government royalty oil from Elk Hills lost its buyer. It would like to give up its contract. It found that isn't easy to do.

The Government, as is proper, protects itself against all contingencies when it makes contracts. Sometimes it's tough on the contractor.

New Engineering Center

. . . in the United Nations Plaza will give 16 engineering societies new offices, library, and hall of fame.

THE NATION'S big engineering societies 3 years from now will have a new home: A 20-story structure on the United Nations Plaza between Forty-seventh and Forty-eighth Streets in New York.

A $5-million fund drive to help finance the $10-million building already has been launched. It was kicked off at a dinner in the Waldorf-Astoria with Herbert Hoover as the principal speaker.

Hoover is honorary chairman of the campaign. Alfred P. Sloan, Jr., is honorary vice chairman.

The $5,000,000 is being sought from industry. It will match $3,000,000 expected to be contributed by members of the various engineering societies and $2,000,000 now available in the assets of United Engineering Trustees, Inc.

The new building will be known as the United Engineering Center. It will consist of a central 20-story tower surrounded by lower structures with landscaped grounds, set back from the Plaza.

The structure will provide about 250,000 sq. ft. of floor space and will replace the present, outmoded 16-story Engineering Societies Building at 29 West Thirty-ninth Street. The old building has proved inadequate for handling affairs of the five founder societies: American Institute of Mining, American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and American Society of Civil Engineers.

Membership in these societies has grown from 16,000 in 1907 when the present building was dedicated to 179,275. They have a student membership of 36,493, making the total, including students, 215,768. Chapters have grown from 258 to 684 and publications from 407 to 1,640. At the same time student chapters grew from 220 to 605.

Other associated organizations which will be located in the new building are American Institute of Industrial Engineers, Inc., American Rocket Society, American Institute of Consulting Engineers, American Society of Refrigerating Engineers, American Water Works Association, Society of Naval Architects and Marine Engineers.

Also planning to use the center are the Illuminating Engineers Society, American Society of Heating and Air-Conditioning Engineers, Inc., the Electrochemical Society, Inc., American Welding Society, Society of Motion Picture and Television Engineers, the Engineering Foundation, Welding Research Council, Engineering Index, Engineers' Council for Professional Development, and American Standards Association.

Besides providing office space for engineering societies, the building also will have facilities for:

. . . **The Engineering Societies Library,** described as the greatest engineering library in the country.

. . . **Engineering hall of fame** to perpetuate contributions of distinguished engineers to civilization.

. . . **Exhibition space** for interpreting to the public all the advances in engineering.

Dr. Mervin J. Kelly, president, Bell Telephone Laboratories, is chairman of the industrial campaign. Carl E. Reistle, Jr., executive vice president, Humble Oil & Refining Co., is a member of the campaign steering committee.

Planning and construction of the building will be handled by the United Engineering Trustees, Inc., owner of the present building and a corporation in which the five founding societies are members. It was founded in 1904 and owned and occupied the Thirty-ninth Street building since 1907.

BUILDERS MODEL of a skyscraper to provide a home for the major engineering societies is demonstrated by Dr. Mervin J. Kelly, chairman of an industry campaign to raise funds to finance the project, and Walter J. Barrett, president of United Engineering Trustees, Inc., which will build and operate the structure.

Texans Take Slap

at oil importing companies in two official actions.

ADVERSE EFFECTS of foreign oil imports on the Texas economy last week led disgruntled Texas officials to:

. . . **Cancel a sale of** school-land oil and gas leases.

. . . **Order a boycott** on state buying from oil companies that exceed their imports quota.

The state School Land Board called off the proposed February sale of leases, and Gov. Price Daniel signed a resolution approved by the legislature ordering the boycott.

One resolution asked the state Board of Control not to accept bids to supply oil or products for state use from delinquent oil importers.

The land board declared that oil imports have depressed the domestic crude market so much it would not be wise to put new leases on the market now.

A prime reason for the board's action apparently was the poor netback to the state from the lease auction held last month by the Board for Lease of University Lands. That sale took in only about $2,700,000 as compared to an expected $5,000,000.

Dennis Wallace, deputy land com-

missioner, told the board at its meeting that oil companies had asked the board to offer school-land tracts totaling more than 355,000 acres at the proposed February sale. He said nine offshore tracts had been sought, but none of these were beyond the 3-mile limit.

Cancelation of the sale drew from Governor Daniel this comment: "This is another evidence of what excess imports are doing to this state. There is no use putting up our school lands at a cheap price to let the oil companies profit still more because of their excess imports."

Alberta Demand Up

after a 6-month tumble. But December nominations are still at low level.

THE DEMAND for Alberta crude oil, which has been plunging steadily for 6 months, took a slight upward turn in December, with purchasers asking for 298,990 bbl. daily.

This is 9,374 bbl. higher than November's nomination of 289,618 bbl. daily, but 137,753 bbl. lower than May's 436,745-bbl. demand.

Just before the deadline for making December nominations, it appeared another decline was in the making. Imperial Oil, Ltd., had prepared to ask for 5,000 bbl. daily for its Sarnia plant, but at the last minute boosted this to 45,000 bbl.

The company decided to start building up stocks instead of curtailing inventories. The boost was assigned to Sarnia, but the stock will probably be spread among other Imperial refineries.

Despite the labor strike at the Vancouver plant, Imperial is again the biggest purchaser of Alberta crude, with a nomination of 74,400 bbl. daily. British American Oil Co., Ltd., is next with 58,715 bbl.

U. S. nominations . . . Refineries in the U.S. will take 76,371 bbl. daily during December. Shell Oil Co.'s Anacortes, Wash., refinery accounts for the largest single portion—27,000 bbl. Next is General Petroleum Corp., Ferndale, Wash., seeking 23,600 bbl.

Nominations from other U.S. refiners include International Refineries, Inc., Wrenshall, Minn., 10,000 bbl. daily; Texaco Exploration Co., 6,060; Lake Superior Refining Co., Superior, Wis., 4,839; Bay Refining Corp., Bay City, Mich., 4,000; Dow Chemical Co., Midland, Mich., 323; West Branch Refineries, West Branch, Mich., 323; and Union Oil Co. of California, Cut Bank, Mont., 323.

Pipeline briefs

United Gas Pipe Line Co. has signed a contract with Lone Star Producing Co. for reserves in Fashing field in Atascosa County, Southwest Texas. Lone Star expects to complete a 10-well program plus gathering and treating facilities in time to start delivery next summer. The project will cost $3,750,000. Deliveries to United will average 50,000,000 to 65,000,000 cu. ft. daily under the 20-year contract. Gross to Lone Star from sale of gas and condensate will be $4,000,000 to $5,000,000 per year.

Laurel Pipe Line Co., which plans a 440-mile, 24 to 14-in. products line from Philadelphia to Cleveland next year, has received bids on a Susquehanna River crossing. Bids for the entire project are expected to be asked in a week or two. Construction is to start early next year. The line should by ready for operation next summer.

Four Corners Pipe Line is nearly completed from southern Utah to the Arizona-California border. Work now is under way on some sections from the Arizona line to Los Angeles. Completion date is February.

The line also has started taking small amounts of crude from fields in northwest New Mexico and southeast Utah as fill.

Texas Illinois Natural Gas Pipeline Co. is winding up its 1957 construction program, a major looping project in the Chicago area. The job is contracted to Midwestern Constructors, Inc., Tulsa. Midwestern expects next week to have the 44 miles of 36-in. and 4 miles of 34-in. in the ground. The line runs from south of Joliet to Howard Street, west of Chicago.

Union Oil Co. of California is laying 90 miles of 4, 6, and 8-in. crude lines from Guijarral Hills to its Coalinga pump station. Union completed all work November 1 on its new crude and products line from Junction pump station to its Oleum refinery consisting of 40 miles of 12-in. and 184 miles of 16-in. Roy Price, Inc., and Ehrhart & Associates were the contractors.

Northern Natural Gas Co. plans to spend $6,000,000 by the end of 1958 connecting new gas supplies to its line in Texas, Oklahoma, and Kansas. Its "budget-type" filing with the Federal Power Commission permits the lump-sum application and avoids numerous small filings during the next year. Northern does not plan to enter any new producing areas and the added supply is not for any expansion of the main line.

Trans Mountain Oil Pipe Line Co. deliveries have been reduced sharply by a strike at one British Columbia refinery and a shutdown for maintenance at another. Throughput in November was 78,000 bbl. daily compared to 108,150 for October. A newly completed expansion program raises capacity to 250,000 bbl. per day, almost double average deliveries of 176,469 bbl. daily this year.

The price has gone up for wellhead gas in Texas' Panhandle field. After a hearing in Amarillo, the Texas Railroad Commission announced that the average weighted price is now 11.2087 cents per M.c.f. at a base pressure of 16.4 psi. and 10.0127 cents per M.c.f. at 14.65 psi.

These prices now become the minimum which may be paid for Panhandle gas used for carbon-black manufacture. Since the commission's last hearing in May, gas prices have climbed 0.39 cent per M.c.f. at 16.4 psi., and 0.3484 cent at 14.65 psi.

Also for Pipeliners . . .

IN THE NEWS: Giant positive-displacement meter successfully passes a year of testing (p. 60) . . . Record gas imports will reach southern California in December (p. 61) . . . Two companies are planning a gas line from Oklahoma to St. Louis, now considered a ripe market (p. 61) . . . Natural-gas industry has just received one of its toughest legal jolts. An appellate court rules all customers must agree to rate increases before they can be approved by FPC (p. 70) . . . Milwaukee grand jury probe of fight for Midwest gas market could become sweeping investigation of entire gas industry (p. 71) . . . Shell plans heated pipeline to move heavy Boscan crude to Venezuelan terminal (p. 76) .

PLUS THESE TECHNICAL REPORTS: New controller recorder gravitometer makes possible the blending of controls automatically to constant outgoing gravity (p. 73) . . . The first LACT system for low-gravity, viscous crudes (p. 82) . . . On-the-job in pipelining (p. 123).

Gas Hit Hard Again

. . . as appellate court rules all customers must agree to rate increases before new rates can be approved by FPC.

THE NATURAL-GAS INDUSTRY and the Federal Power Commission face one of the biggest road blocks raised in nearly 20 years of regulation under the Natural Gas Act.

The District of Columbia Appeals Court, in effect, has scrapped the procedure by which the FPC in the past has granted rate increases to interstate pipelines.

The court held that new rates granted United Gas Pipe Line Co. were invalid because the company had not secured agreements from every customer to pay the higher charge.

It sent the case back to the FPC with an order to reject the new schedules and start proceedings to secure refunds of the extra amounts paid.

New theory . . . Gas lawyers pointed out that in no other regulated industry do customers have the power to set rates as, in effect, they would have if the decision is upheld by the Supreme Court.

They point out, too, that if pipeline rates are frozen there will be a serious impact on independent producers.

Through the life of the Natural Gas Act the FPC has accepted new pipeline rate schedules under Section 4(D), reviewing them under Section 5(E) of the law. Under these provisions, the FPC could suspend the increases for 6 months, then permit them to go into effect under bond. Pipelines kept the escrowed funds if the rates were finally accepted, but made refunds if the increase was denied or pared down.

The case reached the federal courts on appeal by the city of Memphis and the Mississippi Valley Gas Co. from rejection by the FPC of motions to reject United's schedules on sales to the Texas Gas Transmission Corp. and Southern Natural Gas Co.

The decision held that the requirement of all-customer acceptance of new rates held despite a clause in the service agreement that the rate to be charged is the effective rate on file with the FPC "from time to time."

New approach suggested . . . The court suggested that the pipeline companies' only way of getting their rates reviewed would be under Section 5(A) of the act. This section provides for petitions for review of rates on the ground that they are unjust and unreasonable.

Lawyers said this would require a pipeline to complain against its own rates and ask for review. Such reviews take up to 2 years, during which the pipeline could make no increases. Its situation would grow worse each year relief was denied. Pipeline rates could always be "under review" but never raised.

United is expected to fight the decision all the way up to the Supreme Court. If it loses there, it was predicted, Congress next year will be asked to pass a new law clearing up the situation.

Gilsonite Road Mix

tested in Colorado. It can be laid cold and at temperatures below 35° F.

A NEW ROAD-SURFACING product is being tested by American Gilsonite Co. at the firm's unique gilsonite processing plant in western Colorado.

The new road mix, which contains gilsonite ore, can be laid cold, even after the temperature drops below 35° F.—the normal cutoff point for spreading hot-mix asphalt.

Leo Morris, refinery superintendent, said marketing of the mix may start soon, at a cost competitive with current asphalt-paving prices.

American Gilsonite is now experimenting with an ingredient of the mix called plasticizer, an oil-base preparation used to keep the mixture workable. The goal is to develop a mixture of gilsonite, gravel, and plasticizer that will remain workable after being stockpiled for a year.

Roads in the plant area at Grand Junction are paved with the new product, and 24 test stockpiles near the mixing plant are still "fairly workable" after exposure to summer and fall weather, James Kilburn, refinery engineer, said.

The mixing plant is capable of producing 1½ tons of the mixture every 4 minutes. The gravel is fed in at the top and is combined with gilsonite and plasticizer in a small mill at the bottom.

Unique plant . . . American Gilsonite's $13-million plant went on stream last summer. It's the first plant to economically produce gasoline from a raw material other than crude oil. The company is owned equally by Standard Oil Co. of California and Barber Oil Corp.

About 700 tons of the asphaltite is processed daily to obtain 1,300 bbl. of high-octane gasoline and 275 tons of high-purity metallurgical coke daily (OGJ, Aug. 5, p. 58). The ore, found principally in the Uintah basin, is mined and carried to the refinery through a 72-mile slurry pipeline.

Shale's Cost Set

at about 1 billion dollars for 250,000-bbl. industry.

WHEN SHALE becomes a competitor of crude oil, Colorado and California will split the business.

Colorado will be the site of the mining, crushing, retorting, and preliminary refining. California — principal market for shale-oil products— will build an industrial complex to provide almost all of the final processing.

That's the opinion of a team of Pennsylvania University experts who have just completed a study of the potential new industry. They were hired by Colorado Gov. Steve McNichols to project future needs of shale development in the state.

The report said that an industry producing 250,000 bbl. of shale oil daily would require a total capital investment between $805 million and $1.24 billion.

Processing facilities in California will require between $203 million and $490 million; Colorado facilities will take between $602 million and $750 million. Gross daily revenue from a 250,000-bbl. industry would range from $907,431 to $1,201,141.

With adequate storage facilities, the study said, enough water could be obtained from the Colorado River to support a processing system with a capacity of 2,000,000 bbl. per day.

Kermac-Texaco Deal Near

NEGOTIATIONS neared completion last week for purchase by Kerr-McGee Oil Industries, Inc., of The Texas Co.'s gathering and feeder lines in Oklahoma (OGJ, Nov. 11, p. 130).

When the deal goes through, Kermac will take over about 9,000 bbl. of oil per day now gathered by the Texaco lines. Kermac recently bought 1,100 miles of Gulf Oil Corp. gathering lines in Oklahoma, effective January 1.

Gas-Market Fight Under Study

. . . by Justice Department. Government hints Milwaukee federal grand jury also may probe entire gas industry.

THE JUSTICE DEPARTMENT is investigating the fight over plans of Midwestern Gas Transmission Co. to build a big Midwest pipeline system supplied with Canadian gas.

Machinery was put into motion last week for a federal grand jury investigation of efforts of three other pipeline companies to block Midwestern's project.

Victor Hansen, chief of the department's antitrust division, announced Milwaukee will be site of the investigation. The matter came before the department on a complaint by Wisconsin Gov. Vernon W. Thompson. He protested efforts to block natural-gas service to his state.

But more important to the gas industry is this: Justice officials intimate that the grand jury will have unlimited scope. It can study any angle of the natural-gas industry that may be brought up.

Federal court authorization of the grand jury session will permit the department to probe the "production, transmission, importation, distribution, purchase and sale" of natural gas.

Hansen declared the fight between natural-gas pipelines over the rich Chicago region markets has been under study for some months. The Government's interest is to determine if antimonopoly laws have been violated in the fight.

Midwestern's application for permits to import Canadian gas and build a pipeline from Portland, Tenn., north to the Canadian border is still pending before the Federal Power Commission. It is opposed by Peoples Gas, Light & Coke Co., American Natural Gas Co., Northern Natural Gas Co., and other firms now serving the area.

Subpoenas already have ordered these companies to testify: Midwestern Gas Transmission Co., American Natural, Northern Natural, Peoples Gas, Light & Coke, Tennessee Gas Transmission Co., and Panhandle Eastern Pipeline.

In addition, personal subpoenas have been issued to Gardiner Symonds, board chairman of Midwestern, and N. W. Freeman, president. Symonds also is president of Tennessee Gas Transmission, parent firm of Midwestern. They are scheduled to testify January 6.

Midwestern and Tennessee Gas also have been instructed to produce on December 16 company records pertaining to agreements or discussions between competing companies on the purchase, sale, importation, or distribution of Canadian gas in the United States.

Sinclair, Spencer Honored at Dinner

SIX HUNDRED oil-industry executives and leaders in other fields of business and in government attended a dinner in New York November 21 honoring Sinclair Oil Corp. and its president, P. C. Spencer.

The dinner was sponsored by the Newcomen Society in North America and held in the Pierre Hotel ballroom.

Spencer, the guest of honor, was introduced by Gov. Milward L. Simpson of Wyoming.

Governor Simpson pointed out that since Spencer became president in 1949, Sinclair has doubled its assets to $1.4 billion, increased refining capacity from 300,000 to 488,000 bbl. daily, increased crude-oil production from 108,000 to more than 166,000 bbl. daily, and become the seventh largest oil company in America.

Spencer addressed the meeting on the subject: "Oil and Independence—the Story of the Sinclair Oil Corp."

Over the years the national Newcomen organization has honored several leading American industrial corporations.

Industry briefs

Louisiana's oil-production allowable for December has been set at 792,690 bbl. daily, an increase of 9,890 bbl. per day over the November total. The state allowable has remained constant since September except for slight increases to cover new production. The September allowable, low for the year, was 760,168 bbl. daily. High for the year, set during the Suez crisis, was more than 990,000 bbl. daily.

Ray C. Fish will build a new office building in Houston to serve as headquarters for Fish Engineering Corp. and other companies which he heads. Negotiations have been completed for purchase of a 5-acre site. Fish said the new headquarters will cost more than $1 million.

The New Mexico Oil Conservation Commission has set December 19 for a rehearing on an order setting well-spacing in Bisti field at 40 acres. Sunray Mid-Continent Oil Co. sought the rehearing after the commission rejected its plea for 80-acre spacing (OGJ, Nov. 11, p. 123). Among those joining Sunray in the new move were Sinclair Oil & Gas Co., Phillips Petroleum Co., Magnolia Petroleum Co., Southern Union Gas Co., Pan American Petroleum Corp., and Lion Oil Co.

Petro-Atlas Corp., subsidiary of Atlas Corp., has moved its general offices from the First National Building in Tulsa to the National Bank of Tulsa Building.

E. B. Germany & Sons, Dallas independent production company, has moved its offices to a suburban location near Preston Center in North Dallas. Calto Oil Co., a subsidiary, will also be located in the new E. B. Germany & Sons Building.

Mitsui Shipbuilding & Engineering Co. has signed an agreement with Panama Corp., Panamanian subsidary of The Texas Co., for the construction of four 46,000-ton, 17-knot tankers. Completion is scheduled for late 1960.

Oklahoma's oil production allowable will remain at its October-November level for December. The Oklahoma Corporation Commission made no change last week in the 600,000-bbl.-per-day allowable. Because of pipeline proration, production hit about 562,000 bbl. in November.

Two-Well Derrick Makes Bow

. . . in California's first offshore drilling platform. It will have two crown blocks and drill two wells at once.

DESIGNERS of California's first offshore-drilling platform patterned it after those in use on the Gulf Coast.

What makes the whole package different, however, are several new features in deepwater drilling which it will introduce.

The platform is now being built at San Diego for Standard Oil Co. of California and Humble Oil & Refining Co. It will be floated to the companies' jointly held, 5,500-acre state lease offshore from Summerland. Its first test will go to 8,500 ft.

There it will be submerged in 100-ft. water some 2.2 miles from shore. It first will serve as a drilling structure and later as a production platform.

Unusual feature . . . A 140-ft. derrick capable of drilling two wells at once is the outstanding feature of the platform.

Wellheads can be spaced on 6-ft. centers under the 45-ft. square derrick floor. The derrick will be equipped with a 30-ft. crows nest and two crown blocks with separate hoists to allow simultaneous drilling of two wells.

Four 27-ft. diameter caissons will be used to float the 1,500-ton platform to the drill site without drilling deck and equipment. The caissons are designed to provide a draft of about 14-ft. while the huge structure is being towed.

Landing the platform on the ocean floor will be carried out as follows: First, four 350-ft., 9⅝-in. piles will be driven around the drill site. With these securing the platform, a hoisting mechanism in the center of the structure will be used to pull the structure to bottom. Buoyancy of the caissons will be reduced by replacing the air with water.

After the platform rests on the ocean floor, equipment contained in each of the four legs will be used to jet the caissons to bottom. Compressed air will remove the cuttings and lift them to the surface.

When the legs are securely bottomed and the platform plumb, some 700 tons of cement will be pumped into the caissons to anchor them to the ocean floor. The 110-ft. square, three-level drilling deck will then be erected on the platform about 55 ft. above water.

The plans . . . Fabrication of the $2,300,000 platform will start this month at the San Diego shipyards of National Steel & Shipbuilding Co.

It is to be completed about May 1. Between then and July 1, planned date for starting the first well, the platform is to be anchored and the drilling deck and equipment added.

Standard has not revealed results of two 8,450 and 7,387-ft. core tests drilled from a portable DeLong-type platform earlier this year. Some West Coast operators, however, see indications that Standard considers oil possibilities good because a platform is being built which can't be salvaged easily.

Gulf Motions Overruled

THE OKLAHOMA Corporation Commission has refused to back down in its contempt action against Gulf Oil Corp., and the closely-watched case will be aired fully at public hearings December 17-20 in Oklahoma City.

At issue is whether a state regulatory body can force an oil purchaser to seek, and get, special permission from the state before cutting purchases below its allowable.

The commission last week overruled Gulf attorneys on at least 14 motions to quash the citation for contempt. This means Gulf and the commission staff will put on lengthy testimony supporting their conflicting views at the upcoming hearings.

Gulf refused to take its full allowable in August and has prorated buying for much of 1957. It contends the commission has no legal right to require minimum purchases and has announced plans to take the issue to the courts if found guilty of contempt.

Kansas Tax Faces Test Case

THE HOTLY-CONTESTED 1 per cent severance tax on oil and gas production in Kansas will be tested before the state Supreme Court. Hearings will probably get under way early this month.

Constitutionality of the levy has been attacked by county attorneys in six western and central Kansas counties: Wilson, Barton, McPherson, Stevens, Greenwood, and Russell.

The new tax, which passed the state legislature last spring, went into effect July 1. It's expected to yield $4 million annually. Another bill, calling for a 2 per cent levy, was killed earlier in the legislative session.

The 1 per cent tax covers both operating and royalty production at the wellhead. Opponents of the measure argue that half of Kansas' production is by independent operators who, they say, can't stand the additional taxes.

Health Plan Pushed

by OCAW for its members. "Home care" is stressed.

THE OIL, Chemical, and Atomic Workers union is stepping up its drive for stronger health and hospitalization plans. Union President O. A. Knight has asked each local to name a coordinator to gather information.

The OCAW is stressing a "home care" hospitalization plan and may include it in bargaining for the next contracts (OGJ, Sept. 23, p. 72).

At its recent annual meeting, the union adopted a resolution recommending that a central committee review hospital plans now in effect and select the best features of each.

The resolution states that most health plans "sadly neglect" retired and aged employes and those suffering from mental illness. The union has not gained "any sort of substantial coverage" for these persons.

On the home care proposal, the resolution said it should be considered seriously because "health-insurance premiums are rising by leaps and bounds," and efforts should be made to control or cut costs.

Under home care, a comparatively new development in health insurance, the patient is transferred from the hospital to his home and given all the care and facilities offered him in the hospital. Regular visits by the physicians, nurses, and, if necessary, medical technicians with hospital equipment are provided.

The resolution says the national average for a hospital patient is $20 per day, while hospitals operating home care plans are handling such patients for approximately $4 per day.

Some of the leading insurance companies in the metropolitan New York area have made commitments to adopt the home care feature into their hospital coverage.

Calgary Gas Line Planned

CANADIAN WESTERN Natural Gas Co. has announced a $9.5 million development and pipeline program to draw 150,000 M.c.f. daily from the Carbon area northeast of Calgary.

Canadian Western plans to connect

the 200 billion cubic feet of reserves in the Carbon area to the growing Calgary market. Present capacity from Turner Valley, Jumping Pound, Bow Island, and Foremost fields is 235,000 M.c.f. daily.

Shell Oil Co. drilled the discovery well at Carbon in 1955. Since that time Shell and Tennessee Gas Transmission Co. have drilled five more wells. Canadian Western is negotiating for these reserves and plans to drill more wells.

Sun Sued by FTC

in case charging the resale price of gasoline is fixed.

PRICING PRACTICES of East Coast oil suppliers have come under attack from the Federal Trade Commission.

The FTC last week charged Sun Oil Co. with illegally fixing the resale price of its gasoline. It also alleged that Sun forced unwilling independent service-station dealers into unlawful agreements which are unprofitable to them.

The complaint is based on an alleged consignment agreement which Sun put into effect in one Virginia market in November 1956.

The FTC alleged that the plan had the effect of ending a dealer's status as an independent operator since Sun retained title to all gasoline delivered and fixed the price at which it is sold to the public.

"This alleged consignment is a fiction and subterfuge, and its primary purpose is to enable Sun Oil to fix and maintain the resale price of its gasoline to the public," an FTC statement charged.

Oil Bureau for Los Angeles

LOS ANGELES will set up a new department of petroleum management to supervise the growing number of drilling districts.

The city council has passed a new ordinance calling for a department of 6 to 10 employes headed by a general manager with a petroleum-engineering background.

With the development of soundproof operations, oil companies have been successful in gaining public acceptance of drilling in several residential areas. In some cases, drilling is being conducted on acreage offsetting city-owned property. This prompted the city to set up drilling districts as a protection against drainage. Until now, the city had no specific department assigned to these district operations.

Processing briefs

The Texas Co. is going to dismantle its 8,000-bbl. refinery at Sunburst, Mont., after the plant is closed early in 1959. Texaco announced several months ago it planned to discontinue operations at Sunburst when its refinery at Anacortes, Wash., goes on stream in the first quarter of 1959.

There were reports the Sunburst plant might be sold to another operator. Last week, however, W. G. Copeland, general manager of Texaco refining, ended this speculation by announcing the refinery will be dismantled once the Anacortes plant is completed.

Socony Mobil Oil Co. has contracted with Lummus Co. to build a 19,000-bbl. delayed coker at Paulsboro, N. J. Construction will begin early next year with completion slated for early 1959. The new unit will produce 765 tons of byproduct delayed coke per day. It is the fourth to be built by Socony Mobil and affiliates.

At its Lockport, Ill., refinery, The Texas Co. has converted its 9,000-bbl. war-built, fixed-bed Hydroformer to a Platformer. This brings total Platforming capacity at Lockport to 19,000 bbl., representing nearly 30 per cent of crude capacity.

Du Pont has added two new synthetic-rubber plants, a 50-million-pound neoprene plant at Montague, Mich., and a 15-million-pound hypalon unit at Beaumont, Tex. Company also is starting construction of a neoprene plant at Londonderry, North Ireland.

Standard Oil Co. of California has contracted Fluor Corp. to build a $2-million, 275,000-lb. steam generating plant at its El Segundo, Calif., refinery.

Excelsior Refineries, Ltd., is in the engineering stage for a new refinery to be built at the Pas, in West Central Manitoba. The plant is understood to involve an investment of about $1½ million and to have a capacity of 2,000 to 4,000 bbl. Excelsior operates a 4,000-bbl. refinery at Lloydminster, Alta.

The oil industry's first all-transistorized computer-data processing system will be used at Phillips Chemical Co.'s new ethylene plant at Sweeny, Tex. Beckham Instruments, Inc., Los Angeles, built the system entirely around solid-state components. It uses semiconductor devices and magnetic amplifiers in place of vacuum tubes.

At the Phillips plant, the new system will process information from 168 pressure sensing elements measuring both pressure and flow, 200 thermocouples measuring temperatures from —200° to 2,000° F., and stream analysis instrumentation. In addition, the system will provide computed real-time data for optimum process control.

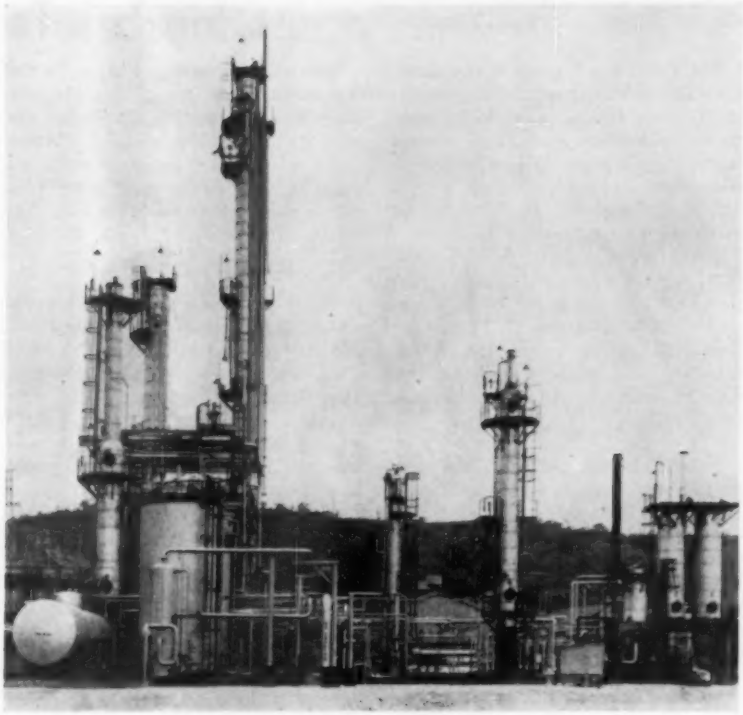
Borden Co. has tripled capacity of its Illiopolis, Ill., chemical operations by completing a new butadiene-styrene plant. Borden also makes polyvinyl acetate, vinyl chloride, and vinylidene chloride at Illiopolis.

A new $750,000 processing plant in the Smiley area of Saskatchewan is ready to go on stream. The plant, owned by four companies, will process 3,000,000 cu. ft. of gas daily for the Saskatchewan Power Corp. The operating company will be known as Smiley Gas Conservation Plant. Owners are Imperial Oil, Ltd., Canada Southern Petroleum, Ltd., Hudson's Bay Oil & Gas Co., Ltd., and Consumers' Cooperative Refineries, Ltd.

Also for Refiners . . .

IN THE NEWS . . . First barge of butadiene is on its way from Gulf Coast to Ravenna, Italy, where new synthetic-rubber plant is under construction (p. 61) . . . Domestic producers open fight to extend imports controls to West Coast (p. 62) . . . Sunray starts a company-wide plan to grow its own bosses (p. 64) . . . Texans take slap at importing companies in two official acts (p. 68) . . . Alberta demand swings upward for first time in 6 months (p. 69) . . . Jones & Laughlin is on stream with two refining units at its Aliquippa Works to make pure coal chemicals as a byproduct of steel (p. 74) . . . World production is still down but U. S. output bounces back, September reports show (p. 75).

PLUS THESE TECHNICAL REPORTS: Catalysts hold key to results obtained in butylene dehydrogenation by the steam-dilution method (p. 87) . . . Nelson Refinery Construction Index (p. 95) . . . How 31 refineries condition cooling-water systems (p. 101).



J&L's new Aliquippa Works where a . . .

Steelmaker Borrows Refiner's Tools

JONES & LAUGHLIN Steel Corp. is on stream with two refining units which are producing the first pure coal chemicals as a byproduct of steelmaking.

The company's new plant at Aliquippa, Pa., has started producing high-grade benzene, toluene, and xylene. A light oil containing these components is produced from the coking of coal to make metallurgical coke for J&L's blast furnaces at its steel plants in Pittsburgh, Aliquippa, and Cleveland.

The $2-million plant combines the Hydrofining and Udex processes familiar to the petroleum-refining industry to extract the chemicals from the light oil. The plant is rated at 55,000 gal. daily of light oil.

The oil from the coke ovens contains a high percentage of aromatic hydrocarbons. Contaminating sulfur compounds and nonaromatic hydrocarbons are removed by the two refining processes. This purified light oil then is separated into benzene, toluene, and xylene by distillation.

A major feature of J&L's new refining process is the ability to separate the benzene, toluene, and xylene as high-purity products without making intermediate materials. This is accomplished by automatic control of highly-instrumented distillation equipment.

New Welex Firm Ready to Go

A BIG NEW wire-line service company is in business.

The new firm, Welex, Inc., welds together the former Welex Jet Services, Inc., and the electrical well services division of Halliburton Oil Well Cementing Co., into a new Halliburton subsidiary.

The merger was completed following approval by Welex Jet stockholders of a $25,000,000 exchange of stock.

Halliburton issued about 360,000 shares of its stock to Welex Jet stockholders for all 863,000 outstanding shares of Welex Jet stock.

The officers . . . Heading Welex, Inc., as president is Ray O. Shaffer, former president of Welex Jet. Other new officers in the Fort Worth headquarters include:

Jack Vaughn, vice president of sales, the same position he held with Welex Jet; Tom E. Morton, former manager of Halliburton's California division, vice president of operations; T. W. Painter, former vice president in charge of administration for Welex Jet, now vice president of manufacturing and administration; and H. T. Jarmon, secretary-treasurer, same position he held with Welex Jet.

Welex, Inc., also will have four vice presidents in field offices. They are: J. B. Fleming, manager of Louisiana Gulf Coast division at New Orleans; G. T. Armstrong, manager of Panhandle North Texas division at Dallas; W. O. Satterwhite, manager of West Texas division at Midland; and H. K. McArthur, manager of the new Texas Gulf Coast division at Houston.

Expansion planned . . . The new company will specialize in jet perforating, radioactivity and electrical resistivity well logging, sidewall coring, and auxiliary services.

Eventually it plans to offer these services world-wide. First step in the expansion plan will be to launch operations in Venezuela. This, company officials say, will be done in the immediate future.

Both Welex Jet and Halliburton operated in the Mid-Continent, Rocky Mountains, the Gulf Coast, and Canada. Halliburton also offered wireline services in California and the tristate area of Illinois, Indiana, and Kentucky.

New Oil Commission

set up in British Columbia to enforce conservation.

BRITISH COLUMBIA has set up a three-man conservation commission that may be the first step in setting up a new oil and gas conservation code.

The committee, which will operate in much the same way as the Alberta Oil and Gas Conservation Board, is headed by A. N. Lucie-Smith, mining engineer with 28 years of exploration experience in Venezuela and Austria.

The other two members are N. D. McKechnie, engineer, who has been with the government's mining department for 19 years, and M. H. A. Glover, former assistant director of the economic bureau of British Columbia's department of trade and industry.

The committee will arbitrate between companies when conflicting interests affect the conservation program, and will conduct public hearings in enforcing conservation.

British Columbia is expected to pass new regulations soon to ensure orderly conservation of oil and gas.

World Output Still Down

. . . but U.S. production bounces back. First impact of import program, Texas allowable spur increase.

FREE-WORLD crude production had a little different look in September. Total output was off for the third straight month, but United States production reversed its recent role and gained in face of the world-wide decline.

The modest U. S. rise largely resulted from a 13-day allowable in Texas—carried over into a 30-day month from the 31-day months of July and August. Further in the background, the voluntary import program was in effect for the first time. Imports were somewhat over the restriction formula, but a lot closer to the formula than to the level originally planned by importers.

Venezuelan production came down another notch from the all-time high in June. The Middle East gained slightly, with Iraq's increase covering the Saudi Arabian decline.

Trends Over the Last Year

	Western Hemisphere less U.S.	Middle East	Total, Free World outside U.S.
1956			
Sept.	3,624.5	3,700.8	7,982.5
Oct.	3,688.3	3,873.5	8,251.8
Nov.	3,760.8	2,142.8	6,544.2
Dec.	3,915.9	2,428.9	6,989.7
1957			
Jan.	3,993.9	2,645.7	7,301.7
Feb.	4,040.7	2,855.5	7,561.6
March	4,117.8	2,764.3	7,582.0
April	4,111.5	3,140.0	7,985.0
May	4,116.0	3,556.1	8,407.3
June	4,160.6	3,957.3	8,872.5
July	4,076.2	3,989.4	8,824.7
Aug.	3,924.5	3,955.0	8,649.6
Sept.	3,746.2	3,968.5	8,487.2

World's Crude Production: Daily Average in Thousands of Barrels

Country—	September 1957	August 1957	September 1956
Western Hemisphere			
Argentina	91.6	91.6	82.9
Bolivia	9.6	9.6	9.0
Brazil	24.0	30.0	11.6
Canada	475.0	506.0	503.8
Chile	11.9	11.9	10.3
Colombia	123.1	127.1	122.8
Cuba	1.0	1.0	1.7
Ecuador	7.7	7.7	9.0
Mexico	240.0	240.0	249.3
Peru	52.8	52.8	50.9
Trinidad	96.3	95.3	80.2
Venezuela	2,613.2	2,751.5	2,493.0
Total	3,746.2	3,924.5	3,624.5
Western Europe and Africa			
Algeria	0.2	0.2	0.5
French Morocco	1.5	1.5	1.9
Egypt	45.8	45.8	39.6
Gabon	3.5	3.5	.....
Austria	57.7	57.7	65.4
France	26.7	26.7	26.3
West Germany	78.6	78.6	70.6
Italy	27.5	27.5	13.0
Netherlands	31.4	30.9	21.5
Turkey	6.2	6.5	4.7
United Kingdom	1.6	1.6	1.3
Yugoslavia	8.0	7.7	5.9
Total	288.7	288.2	250.7
Middle East			
Bahrain	34.2	34.1	30.1
Iran*	770.0	767.0	581.0
Iraq†	591.4	491.6	765.2
Israel	1.2	1.2	0.7
Kuwait	1,283.6	1,286.0	1,123.6
Neutral Zone	78.0	75.0	30.3
Qatar	155.1	148.0	122.0
Saudi Arabia	1,055.0	1,152.1	1,047.9
Total	3,968.5	3,955.0	3,700.8
Other Asia			
British Borneo	118.0	118.0	118.1
Burma	9.2	9.2	4.8
India	8.5	8.5	9.2
Indonesia	330.0	328.0	255.2
Japan	6.3	6.1	5.9
New Guinea	5.9	6.2	7.4
Pakistan	5.9	5.9	5.9
Total	483.8	481.9	406.5
Free World			
Foreign	8,487.2	8,649.6	7,982.5
United States	6,887.0	6,786.0	7,054.0
Total	15,374.2	15,435.6	15,036.5
Communist Countries in Soviet Orbit			
Romania	220.0	220.0	218.0
Russia	2,000.0	1,975.0	1,600.0
Others	50.0	50.0	50.0
Total	2,270.0	2,245.0	1,868.0
World Total	**17,644.2**	**17,680.6**	**16,904.5**

*Includes 4,000 bbl. daily from Naft-i-Shah field not operated by consortium companies.

†Includes estimated 3,600 bbl. daily from Naft Khaneh field, operated by British Petroleum Co.

Figures are from reliable industry reports or official government sources. Data for Communist countries in the Soviet orbit, which includes the European satellites and Red China, are based on competent estimates. Authentic information is not available on month-to-month production in these areas. Estimates also were made for those countries where complete reports are lacking.

New Bolivian Concession

. . . may go to three U.S. companies. White Eagle International would operate huge spread in central region.

THE BOLIVIAN GOVERNMENT is expected to grant a 2,223,900-acre oil concession to three U.S. independent oil companies sometime early this month.

The three firms which have filed application for the huge spread in central Bolivia are White Eagle International Oil Co., Blackwell Oil & Gas Co., and Western Hemisphere Petroleum Corp., all headquartered in Tulsa.

The concession, if granted, will be operated by White Eagle International, an affiliate of White Eagle Oil Co. and a sister company to Helmerich & Payne, Inc., Tulsa drilling contractor.

The request was made in September, and the Bolivian Government published final notice of application November 7. This was followed by a 15-day period for competitive bidding. White Eagle officials say they know of no competitive bids for the acreage. An executive decree is expected within 30 days of the November 7 public notice.

The terms . . . The agreement is based on standard provisions of the 1955 Bolivian oil code. This calls for an 11 per cent royalty on any crude oil produced in Bolivia's Zone 1, where more than 1,200,000 acres of the proposed concession is located.

Another 988,000 acres are located in Zone 2. In this area, the government can reduce royalty from 11 per cent to 7½ per cent during the first 15 years of development.

Bolivian law also provides for tax on 30 per cent of net profits, but in computing the profit, operators are permitted 27½ per cent depletion allowance. If profits from development are considered "excessive" the Bolivian Government can share in 50 per cent of the profits.

No bonus is paid for acreage, but a minimum exploratory obligation is required. In Zone 1, operators are obliged to invest at least 80 cents per hectare per year, and in Zone 2, 50 cents per hectare per year.

Operators must start exploratory work within 6 months of granting of concession, but they can wait 4 years to fulfill minimum obligations. If after 4 years, the minimum is not fulfilled, operators could lose the concession.

White Eagle International officials say an exploratory program will be formulated soon after the concession is granted.

The acreage is located east of La Paz, and northeast of the town of Cochabamba. This is north and east of established production in the country. The acreage borders on blocks held by Shell Prospecting Co., Ltd.

Interest perks up . . . Standard Oil Co. (N.J.) had concessions in Bolivia in 1921, and 10 years later brought in Camiri field. But the company's holdings were expropriated in 1937 by a military government, and most oil operations thereafter were handled by the government.

But in 1955, a new oil code was passed which is generally favorable to foreign capital. Since then, interest has picked up considerably.

A number of American firms have interest in Bolivia now, including Bolivian Gulf Oil Co., a four-company combine, and Chaco Petroleum, S.A., another four-company combine. These two firms are currently drilling in Bolivia, and Gulf is helping the country build a 217-mile crude line from Sicasica, Bolivia, to Arica on the Chilean Coast (OGJ, Nov. 25, p. 78).

Bolivian Gulf is owned by Gulf Oil Corp., Falcon Seaboard Drilling Co., Williams Brothers, and Barry & Reiner, Inc. Chaco Petroleum, S.A., is owned by Tennessee Gas Transmission Co., Union Oil & Gas Corp. of Louisiana, Lion Oil division of Monsanto Chemical Co., and Murphy Corp.

The $10-million line will be completed by October 1958, and should be a stimulus to exploration in the inland country. Last year's production in Bolivia averaged about 9,500 bbl. daily, which is greater than domestic demand of about 6,000 to 8,000 bbl. daily.

Boscan Region Humming

. . . with activity after Socal develops market for this once orphan Venezuelan crude. Shell also steps up its production, plans heated pipeline to move heavy oil.

A CINDERELLA STORY is being enacted in the Boscan-crude producing area of Venezuela.

The heavy and viscous Boscan once was the outcast of all Venezuela oil. But that was before Richmond Exploration Co., a wholly-owned Standard Oil Co. of California subsidiary, began developing its Boscan crude.

Richmond suddenly discovered a ready market for the crude and also for the heavy fuel oil, asphalt, and wax cuts made from it. As a result, by midyear Richmond was producing more than 93,000 bbl. daily from Boscan.

Shell enters . . . Naturally, Richmond's success didn't go unnoticed.

Boscan attracted the attention of Cia. Shell de Venezuela, and the Shell company moved into the field in a big way.

Shell already has 20 producing wells in its portion of the Boscan-producing area. It is drilling more. By the first quarter of 1958, Shell expects to be moving 18,000 bbl. daily of the crude by heated pipeline.

The production will move to Shell's new $84-million deepwater terminal on the east shore of Lake Maracaibo (OGJ, Sept. 2, p. 106).

Shell's Boscan field was discovered in 1951. But it never was actively developed until now. It lies in the company's La Concepcion district on the west side of the lake, and covers about 9,000 acres.

The pipeline . . . Shell's newly developed field will be linked with a large-diameter pipeline to the new Punta Gorda terminal.

Shell isn't talking yet about pipe sizes, but this much is known: The line will have a daily capacity of 75,000 bbl. And this probably will put it in the 16-18-in. class.

The line will have two intermediate heating stations. One will be located at La Concepcion and the other at Puerto Caballo on the lake. The heating stations will be necessary to move the heavy, viscous crude through the line. Its average gravity is about 10°.

Two 160,000-bbl. tanks at the new Punta Gorda terminal will be designed especially for the Boscan output. They will be connected to a buoy mooring point so that the crude can be offloaded even before the new terminals piers are completed. Work on the Boscan pipeline and storage will start in January. Both are scheduled for completion by April.

Venezuela's new line to El Palito pier means . . .

Brighter Outlook for Barinas

A BIG FUTURE lies ahead for the Barinas area of Western Venezuela, now that the new 210-mile pipeline is moving Barinas crude to El Palito on the Caribbean Coast.

The $26-million line provides the first direct access to world markets for Barinas—one of the three important producing areas of Venezuela. It will mean a stepped-up exploratory and development program for an inland area that waited 10 years for an outlet to the sea.

The pipeline is the largest 20-in. crude carrier in Latin America. It traverses jungles, rice-growing plains, and mountains before it terminates at the new ½-mile long pier 7 miles west of Puerto Cabello.

Built by Socony Mobil Oil Co. de Venezuela and Sinclair Oil & Refining Co., the line is designed to handle 100,000 bbl. of crude daily, with a potential of 150,000 bbl. Initially, the line is moving 40,000 to 60,000 bbl. daily. Effective last week, Socony posted price for 26°-26.9°-gravity Silvestre crude at $2.55 per barrel f.o.b. El Palito.

When the first valve was turned late last month, the first tanker to tie up to the pier—the SS Mobiloil—was loaded at the rate of 30,000 bbl. per hour. This first cargo of Barinas crude was bound for the Canary Islands.

Loading at the pier is by gravity flow from five 267,500-bbl. tanks located on a hill more than 250 ft. above the shore line. Two tankers can be tied up at the new pier simultaneously.

Big reserves . . . Socony, which will operate the new pipeline, first discovered oil in the Barinas-Apure basin in 1947, but development was slow because of lack of an outlet to tidewater. Socony now has 21 producers at Silvestre field and two more at Silvan field.

More attention was focused on the area in 1953 when Sinclair found production on an adjacent concession. Sinclair now has about 33 wells in Barinas field.

Sinclair's first wells tested from 1,300 to 1,600 bbl. of 25° to 27°-gravity oil daily from three sands, the deepest at 8,986 ft. By 1955, the company had drilled less than 10 wells and estimated reserves on its 11,000-acre concession at 66,000,000 bbl. Socony has never revealed similar information for Silvestre and Silvan pools.

Besides serving these three fields, the new line will stimulate development of nearby concessions granted this year by the Venezue'an Government.

Just west of Silvestre, Venezuela-Atlantic Refining Co., operator of a new 10,800-acre concession, will spud a 10,000-ft. wildcat the first of the year.

Big Soviet Oil Plan

is outlined by Khrushchev. Fourfold increase predicted in next 15 years.

SOME GRANDIOSE PLANS for increasing oil and gas production in the Soviet Union were revealed by the Communist Party Leader Nikita Khrushchev during the recent anniversary celebration of Bolshevism.

Khrushchev, in a speech observing the fortieth anniversary of the Bolshevik revolution, said Russia will quadruple oil production in the next 15 years, and will increase gas production at a much greater ratio.

The Communist party chief said daily oil production will average about 1,960,000 bbl. this year, but by 1972 production will be hiked to between 7,000,000 and 8,000,000 bbl. per day.

This year's production is about 20,000 bbl. per day higher than the production goal of 1,940,000 bbl. daily. In 1956, oil output averaged about 1,676,000 bbl. per day.

He called for wider use of oil and gas to replace coal in the national economy, but he conceded that Russia "lags badly in this regard."

"It is sufficient to say that natural-gas output in the Soviet Union accounts for only about 4 per cent of over-all production of basic fuels, although our country has rich natural-gas reserves."

He said the Russians plan to increase natural-gas production by 13 to 15 times in the next 10 to 15 years, to a total of about 10,417,630 million cubic feet per year. In 1956 annual production was only 483,802 million cubic feet.

He pointed out that it costs almost 12 times less to produce natural gas than it costs to produce the equivalent in coal. The net cost of producing oil in Russia is about 3½ times less than the cost of producing coal, he said.

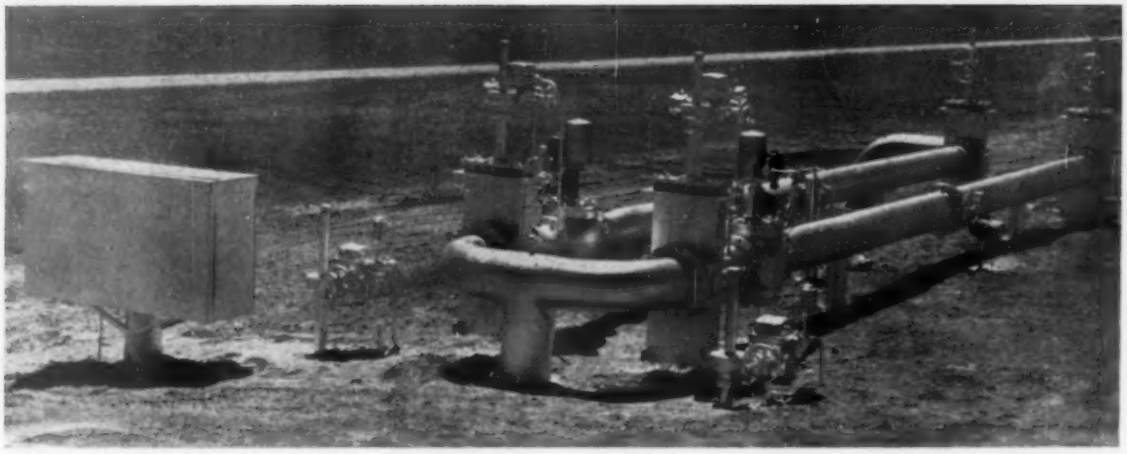
Getty Plans German Refinery

GETTY OIL CO. has confirmed plans for a major refinery in West Germany.

The company's legal advisor in Germany, Dr. Kurt Kersken, said the company has an option on a 440-acre site on the Rhine River near Rees. A tanker terminal on the river also is planned. Dr. Kersken estimated the refinery and terminal will cost $95,000,000.

Getty holds an undivided half-interest in a concession in the Saudi Arabia-Kuwait Neutral Zone. Production from the concession is about 75,000 bbl. daily.

Fig. 1



New controller recorder gravitometer

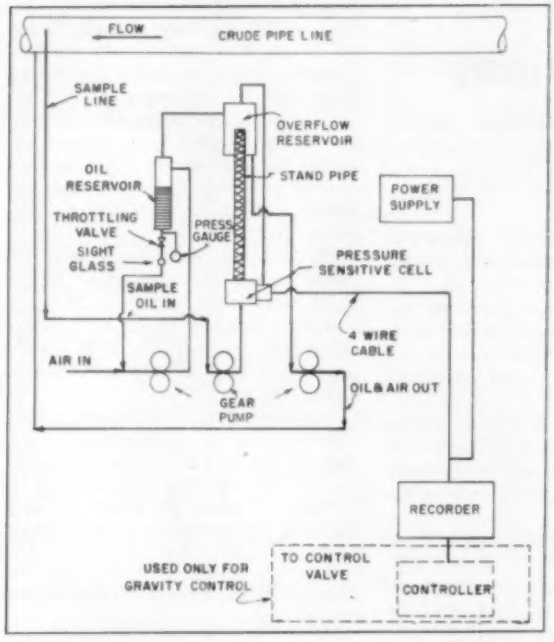


Fig. 2

makes possible blending crudes automatically to constant outgoing gravity

. . . it's fast, sensitive, accurate

By Henry A. Brainerd and John J. Piros

SINCLAIR Pipe Line Co. has been interested in the development of an accurate ($\pm 0.1°$ API), fast-response, continuous gravity recorder for some time for two reasons. First, it was felt that the gravitometers which are now in use are too sluggish and too hard to keep in proper calibration for the satisfactory recording of gravity. Second, the automatic blending of two different crude oils to a constant outgoing gravity was desired, and to accomplish this a fast response, sensitive, accurate gravitometer was absolutely essential.

Some time ago, the Sinclair research laboratories were requested to develop such an instrument. A unit embodying a Statham differential pressure gage was devised, fabricated, and then installed at Flanagan station, Illinois, and has undergone continuous testing. Flanagan station was selected because it is the blending station controlling crude deliveries on the Sinclair Pipe Line system into the Chicago area and was therefore an ideal test location for gravitometer control.

The performance of the gravity-control system using the gravitometer described here has been very encouraging. It is now definitely established that two crude oils can be blended automatically to a constant outgoing gravity with a tolerance of $\pm 0.1°$ API. With such a system the operator merely has to adjust the set-point index to the desired outgoing gravity and the control system will automatically maintain this gravity.

Continuous Recording Gravitometer

The continuous recording gravitometer basically involves continuously weighing a column of oil of a fixed height. The sensing element in this device is a Statham differential pressure transducer Model PM60TCa, having a range of ± 1.0 psi. The heart of this transducer is an unbonded strain gage, which is in essence a Wheatstone bridge so arranged as to cause two legs of the bridge to be put under additional tension as the pressure on the active side of the cell is increased. At the same time the remaining two legs are relaxed, thus causing an unbalance in the bridge resistance. The degree of change of resistance is directly proportional to the change in pressure between the active and reference portions of the differential pressure gage.

Instrument Details

Fig. 2 is a schematic diagram of the device. A sample is continuously taken from the flowing pipeline. It is pumped at the rate of 12 l. per hour through one side of the differential pressure gage which is located at the bottom of a standpipe having a fixed height of 16 in. The standpipe itself is a tube with a ½-in. i.d. This diameter is large enough so that the friction drop of the flowing sample in the standpipe cannot be detected by the gravitometer. The top of the standpipe terminates inside a 1-in. tube. The overflow from the standpipe is removed from the 1-in. tube by an outlet pump having a capacity of 18 l. per hour. The capacity of 6 l. per hour resulting from the capacity differences between the outlet pump and the sample supply pump is used for air removal.

In order to prevent the evolution of any possible bubbles which would invalidate the measurement of the column weight of oil, the unit is run under pressure. This is done by pumping air at atmospheric pressure at the rate of 18 l. per hour into the space above the standpipe. Since the outlet pump has a capacity of only 6 l. per hour available for air removal, the air supplied has to be compressed to a third of its volume or 30 psig. before leaving the unit. This air pressure above the column of oil is also imposed on the reference side of the Statham gage.

The above-described unit is immersed in a constant-temperature oil bath with a capacity of 15 gal. This bath is agitated by an electrically driven stirrer. The temperature is held to a constant value above flowing temperatures in the line by means of a mercury thermoregulator which controls a mercury relay that energizes a 500/1,000-watt calrod. The unit is then calibrated against hydrometer readings to record the API gravity at the standard temperature of 60° F. In this way the unit is immune to flowing temperatures in the line and reads true API gravity without the necessity of temperature-compensating devices.

The immersed Zenith gear pumps are mounted in tandem and are driven by a chain from above the oil level by a constant-speed Bodine gear motor having a 173 r.p.m. output. The Zenith pump which pumps air into the unit is provided with a recirculating oil system using pump discharge pressure to recirculate the oil. Fig. 4 is a photo of this sampling unit. A weatherproof cover is provided for this unit.

The millivolt recorder can be located remotely from the gravitometer since the only connection between the two is a four-wire shielded cable. This makes it possible to place the gravitometer at the most desirable location and still have the recorder in the control room for convenient reading.

The millivolt recorder, which has a 0-2.5 mv. range, has a gravity range from 20° to 50° API. It is supplied with a chart indicator reading directly in °API, and it is planned to have charts made which will also read directly in °API.

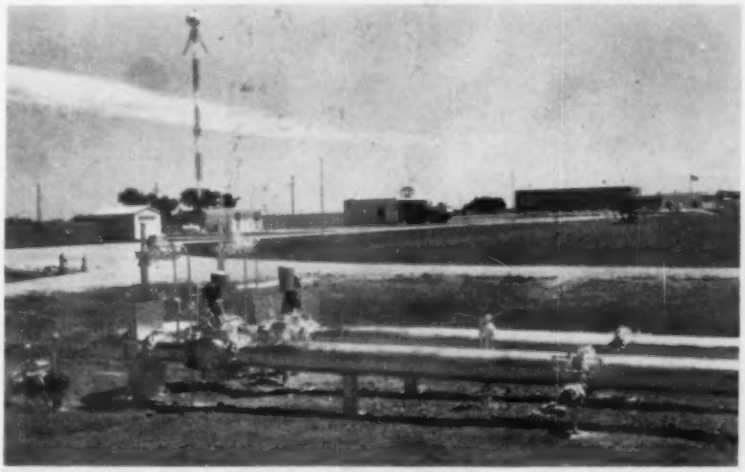
Sensitivity and Stability

The continuous recording gravitometer has a lag of about 30 to 35 seconds for 90 per cent response to a change in gravity. About 20 to 25 seconds of this is result of actual physical lag caused by holdup in the sample line and preheating coil between the sampling point and the bottom of the standpipe. The unit will respond to a change in gravity of 0.1° API. The change in pressure measured by the differential gage at the bottom of the standpipe amounts to 0.087 psi. for a change from 20° to 50° API. This means that for this instrument to detect a 0.1° API change in gravity, it has a sensitivity capable of detecting 0.0003-psi. change.

Field Installation for Recording

The continuous gravity recorder was installed on the suction manifold at Flanagan station and remained under continuous test as a recording instrument for approximately 5 months. The crude sample was taken from the same sample line that supplied the existing gravitometer so that a fair comparison of the two instruments could be made. An additional connection was installed on the supply so that crude-oil samples could be pumped into the instrument by a gear pump for calibration purposes.

The sampling point was located approximately 650 ft. downstream from the point where the crude oils were being blended which resulted in an inherent lag of 2 to 4 minutes from the time a blend was made until it entered the sample line. The milli-



BLENDING AREA of gravity-control system is in foreground. Control center is building in upper right corner. Fig. 3.

THE AUTHORS

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Henry A. Brainerd is in the research and development section of Sinclair Pipe Line Co. but for the past year he had been on temporary duty at the Sinclair research laboratories. An M. E. from University of Delaware, he joined Sinclair Pipe Line in 1952 as senior engineer and participated in the construction of the Harbor Products System between New York and Philadelphia. After construction he was made district engineer for the system.

J. J. PIROS

John J. Piros joined the research department of Sinclair Refining Co. in 1942, where he engaged in pilot-plant operations and commercial process design. Since 1946 he has specialized in instrumentation and apparatus research and development. He holds a Ch.E. degree from University of Illinois.

volt recording instrument was located in the control room for convenient reading.

Very satisfactory results were obtained during this test. The instrument showed a response time of approximately 35 seconds for 90 per cent recovery, a sensitivity slightly better than ±0.1° API, and accuracy of ±0.1° API. This indicated a marked improvement over the existing gravitometer with a response time of approximately 15 minutes for 90 per cent recovery and a sensitivity and accuracy of ±0.2° to 0.3° API. Fig. 5 shows a 7-hour recording of the new gravitometer with appropriate gravities labeled and demonstrates clearly the fast response and sensitivity of the instrument.

Field Installation to Control Gravity

At the end of 5 months' testing it was decided that the development of the gravitometer was complete and that it could now be used as a means of controlling the gravity of outgoing blends. Because the 3 to 5-minute lag between blending and sampling points could not be tolerated for satisfactory control action, it was necessary to relocate the instrument close to the blending point to reduce the response time. Therefore, the instrument and sampling line were located approximately 15 ft. from the blending point directly over the main line to the station manifold.

Tests were conducted to determine the total time lag at the new location between control-valve movement and 90 per cent response of the gravitometer. These tests indicated a response time of about 1 minute with very little variation. This small variation was expected since only about 5 seconds elapse from the time the crude passes through the valve until it reaches the sampling point and this is the only part of the time lag which varies with varying flow rates.

Locating the sample line so close to the mixing point created the problem of having complete mixing at the sampling point so that a representative sample of the blend would be obtained. At the same time it was important to keep mixing - pressure losses to a minimum to avoid wasted power and money. After considering these factors, it was decided to mix the two crude oils by joining the individual streams at a tee connection causing a direct impingement of the streams on one another (see Fig. 1). The piping arrangement required another tee between the mixing and sampling points and it was felt that the combined effects of these two tees would cause complete mixing.

Sampling and mixing . . . The validity of this theory was tested after the installation was complete in the following manner. With a stabilized blend going through the line, crude samples were taken at the gravitometer sampling point and at the station discharge line past the last pump. The approximate time required for the crude to travel between these two points was determined and the latter sample was taken that length of time after the gravitometer line was sampled.

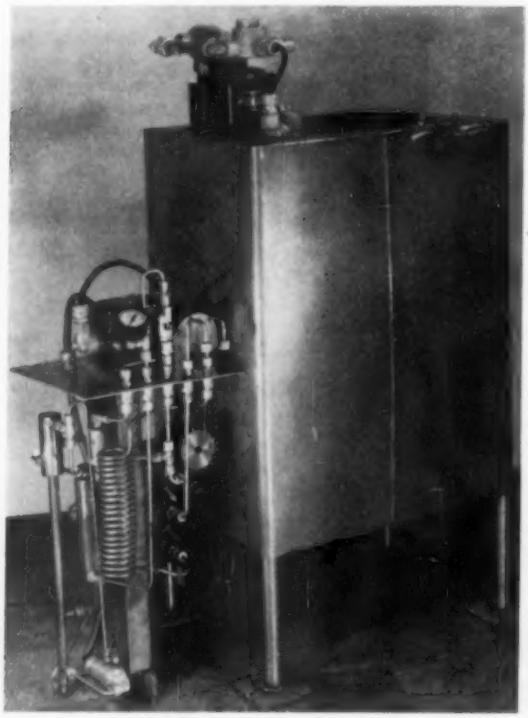
In this way the same crude was sampled at both points so that any small variations of gravity with time would not introduce any error. Gravity tests were then run on these samples and the results compared. If both samples indicated the same gravity, it could be assumed for all practical purposes that a representative blend was being supplied to the gravitometer.

This test was conducted on all of the various types of blends leaving the station and in every case the gravities at the two points were the same. With proof that representative samples were being taken, it was obvious that the mixing was entirely satisfactory for this particular system.

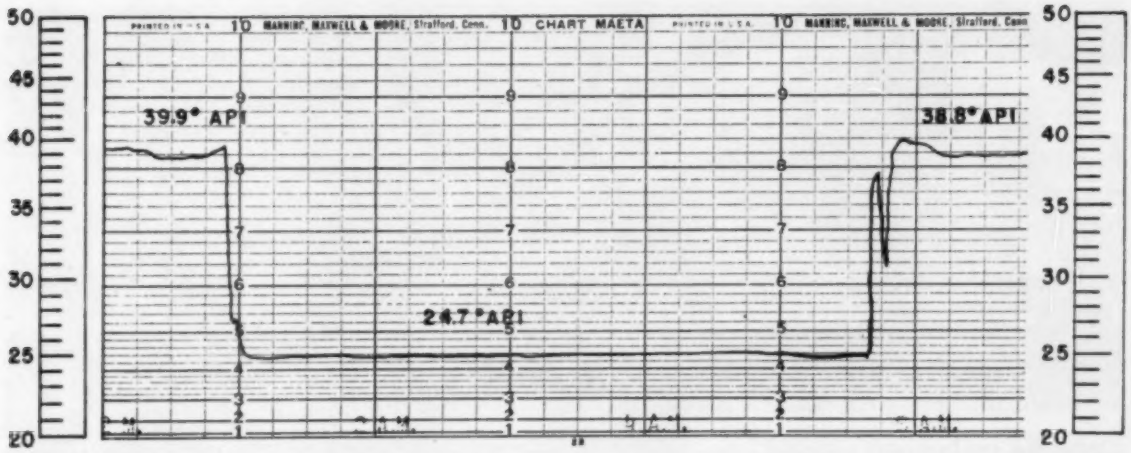
Control system . . . The output from the gravitometer had to be adapted to function in a Microsen control system which controlled the operation of a control valve on each of the two blending lines (see Fig. 1). The Microsen control system was selected because it uses a 0.5 to 5-ma. signal which was thought to be more reliable for this type of installation with an appreciable distance between the control valve and the controller. The output from the gravitometer is a 0-2.5-mv. signal which in turn drives a Brown millivolt recorder.

At first it was thought that a transmitter which would convert the 0-2.5-mv. signal to a 0.5 to 5.0-ma. signal would be the simplest solution. However, some difficulty was experienced in finding such a transmitter, so a worm-gear drive was attached to the recorder. It converted the 330° rotation of the millivolt recorder to a 23° rotation of the Microsen balance transmitter which corresponds to a 0.5 to 5-ma. output. This signal is then fed to a controller-recorder at the control room which in turn actuates the proper control valve to give the desired gravity as dictated by the set-point index.

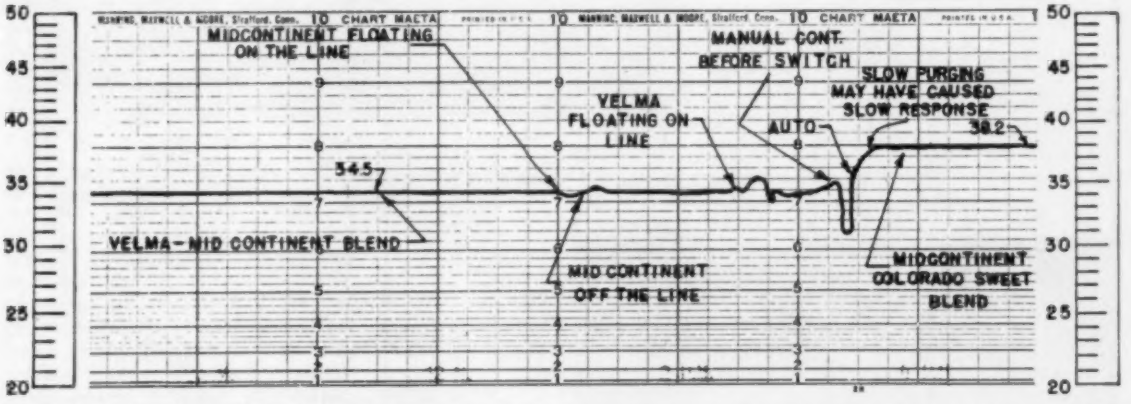
The performance of this gravity-control system was even better than expected. After optimum proportional band and reset settings were determined, the control system consistently held the outgoing gravity of the blend to ±0.1° API. Fig. 6 shows an 8-hour recording of the gravity while the system was under gravity control. The close control and stable response to upsets are quite evident.



Gravitometer working parts are shown along with constant-temperature bath in which they are immersed. Fig. 4.



GRAVITY RECORD for 7-hour period demonstrates fast response and sensitivity of the instrument. At 5:40 a.m. a crude change occurred and different gravity oils were purged from manifold. Record shows two sharp reversals in gravity in less than 5 minutes. **Fig. 5.**



FINE GRAVITY CONTROL and stable response to upsets are shown. Blend received at the refinery was identical to dispatcher's request. **Fig. 6.**

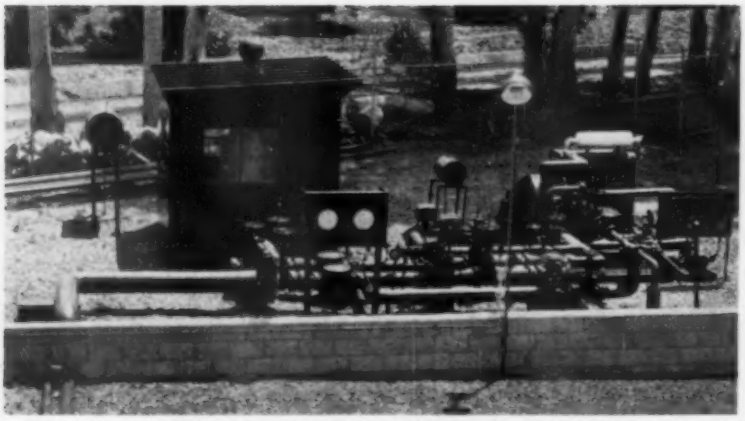
Because the gravitometer - control system can only control blending when there is a difference in gravity between the two individual crudes, it is important to determine the minimum gravity difference which would still give stable control. In this particular installation there are rare occasions when the gravities of the two crudes are almost identical. In the vast majority of the cases, however, the gravity difference varies between 2.5° and 12° API.

While testing the gravitometer-control system, crudes were blended having gravity differences as small as 2.5° API with no difficulty. Flow recorders on the individual blending lines indicated a steady flow in both lines with no noticeable cycling. This indicated a very sensitive control system because with small gravity differences a small change in specific gravity would result in a relatively large change in flow. Therefore, unless the system is quite sensitive, the gravitometer could be recording a straight line while the flow recorder indicated a cycling operation.

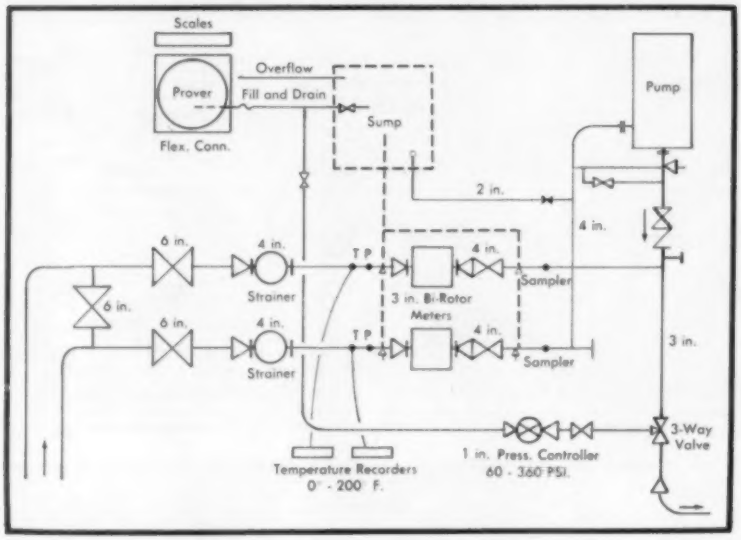
Control circuit . . . In order to have flexibility in a gravitometer - control system, the control circuit must be arranged so that the control valve can be either direct or reverse acting. This is necessary because the direction the valve should move to give a desired change depends on whether the controlled flow is heavier or lighter than the uncontrolled flow. Before a given blend can be put on gravity control, it must be determined whether direct or reverse action is required and the control system set accordingly.

There is a precaution which must be taken when switching from one blend to another if the control must be changed from direct to reverse acting or vice versa. Before the action of the valve can be reversed, the blending lines must contain the new crudes to be blended or the system will go out of control. If the individual blending lines are very long it can mean a delay of several minutes between the time the switch is made and the new blend reaches the control system. The simplest way to determine when the new blend has filled the control system piping is to watch for a significant change in the gravitometer reading. The control system can then be changed to regulate the new blend. **End.**

"Buddy, could you spare a little dry-hole money?"



Only the scales and related proving equipment are



housed for protection from weather in . . .

First LACT System for low-gravity, viscous crudes

By D. H. Stormont
District Editor

THIS automatic-custody-transfer system is being operated by Union Oil Co. of California in Yorba Linda field near Los Angeles.

It is the first in the state where one company buys crude directly from another by use of positive-displacement meters. Of its several unique features the gravimetric proving system is of particular interest. A novel method of sampling results in weekly composite samples which check very closely with those obtained manually over the same period of time.

The automatic facilities are being used by Union to purchase about 2,200 bbl. of crude daily from Western Gulf Oil Co. Operation began last October. Experience with the gravimetric proving procedure, plus the use of a recently developed thermometer which responds immediately to temperature changes, has increased accuracy to the point where meter factors in the order of 0.9975 are obtained.

Material for this article was taken from a company report prepared by D. A. Smith, Union Oil Co. southern division pipeline engineer.

Western Gulf facilities . . . The Western Gulf crude comes from two areas approximately 1 mile apart. The 34 wells in a 600-ft. pool produce a 12.8° A.P.I. gravity, highly viscous crude. This essentially gas-free production is metered and sampled as it leaves the lease.

The combined oil and water are delivered through gathering lines to a dehydration and heating center. Meters provided on the gathering lines at this point check the various stream totals against the sum of the lease meters. Dehydrated crude is continuously transferred to the portion of the field which produces at a greater depth.

In this area, Western Gulf has 36 wells which produce 15° A.P.I. gravity, high-viscosity oil. Each lease is equipped with a metering separator. A gathering line common to all leases delivers the oil output to another centrally located dehydrating and heating center. After the gas has been metered, it is returned to the gathering line along with the automatically metered and sampled crude stream. Wellhead energy flows the production through the gathering system to the separation center.

The separation center . . . At this point the production enters a 7 by 16-ft. gas-oil separator. Overhead gas goes into a 3-in. line which returns surplus gas to the 600-ft. area for well heating and oil treating.

Heat and chemical treating are used to effectively dehydrate wet oil from the deeper pool. A temperature of approximately 175° F. is maintained in the wash tank. About 24 hours' settling time is required for best cleaning results.

Oil from the wash tank flows into a 2,000-bbl. stock tank equipped with heating coils. Additional water dropping out of this tank is bled off daily. Overflow from this stock tank is merchantable oil (contains less than 3 per cent b.s. and w.) which is delivered to either or both of two 2,000-bbl. storage tanks to provide surge capacity for Union's automatic-custody-transfer (A.C.T.) unit.

Under present methods of operation, the clean 12.8° A.P.I. gravity crude is delivered into the suction line ahead of Union's pipeline meters.

Fig. 1

No. 102

METER TICKET

Union Oil Co. of California

Southern Division Pipe Line Department

Name of Lease Western Gulf

Location Yorba Linda

Date 2/20/57 Run No. 1

Counter No.	Meter Reading
23 AX	003349
23 AX	003097
Gross Gallons	252

Make of Meter 3" BRODIE

Average Line Temperature of 150° F.

Signature J.A. Smith

Company U.O.C.

Signature Thurmond

Company W.P.C.

Fig. 2

FLOW METERS are equipped with dual counter-printer attachments. Meter ticket is inserted in the printer before starting the run, and the reading is recorded on the counter totalizer and is printed on the ticket as shown at right.

No. 101

WEIGH TICKET

Union Oil Co. of California

Southern Division Pipe Line Department

Gravimetric Prover

Name of Lease Western Gulf Location Yorba Linda

Date 2/20/57 Run No. 2

2117 ½ Gross Weight Lb.

0152 ½ Tare Weight Lb.

1965.0 Net Weight Lb.

Signed by J.A. Smith Signed by Thurmond

Company U.O.C. Company Gulf

Fig. 3

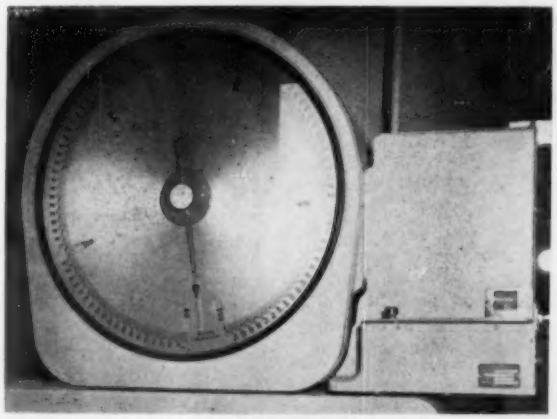


Fig. 4

A WEIGH TICKET is inserted in an electric automatic printer attached to the scale. This device, shown at right, allows remote printing of the weight as registered on the scale dial.

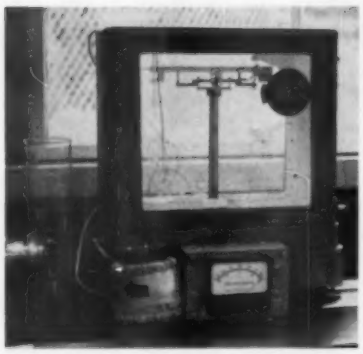
There it commingles with the 15° A.P.I. crude to produce a 14.5° to 15° A.P.I. blend. However, the lower-gravity crude can be received into one of the 2,000-bbl. tanks, or taken directly into the A.C.T. system through a second meter run.

A.C.T. facilities . . . The A.C.T. installation falls in the positive-displacement-meter category. It consists of the two positive-displacement meters, a dial platform scale and 350-gal. prover tank, back-pressure diaphragm control valve, a 30-hp. gas-engine-driven shipping pump, two sampling units, two 0°-200° F. temperature recorders, and two 1-hp. electric-motor-driven gear-type circulating pumps. (A detailed description of this equipment is given in an appendix.)

The platform scale and other related proving equipment are housed in an 8 by 11-ft. prefabricated metal building. This is regarded as essential for protecting the intricate equipment from the weather. Layout of the equipment is shown in an accompanying photograph and a schematic diagram of the A.C.T. installation is also shown.

Heating . . . The entire piping manifold, including the meter and strainer bodies, is lagged with ½-in. copper tubing. Hot water, at about 200° F., is circulated through the tubing to maintain shipping temperatures at about 150° F.

This circulating system was considered to be the most satisfactory means of controlling the viscosity of the



SPECIFIC GRAVITY of the crude in the proven tank is determined from a 500-ml. representative sample which is placed inside a controlled-temperature heating jacket inside this balance. Fig. 5.

oil; to gain as continuous and trouble-free operation as possible. The 12.8° A.P.I. crude has a viscosity of 20,000 S.s.U. at 100° F.; the 15° A.P.I. crude, a viscosity of 3,800 S.s.U. at 100° F. Examining the viscosity characteristics of the crude readily indicates the importance of applying heat if efficient pipeline handling is to be realized.

Some sections of the proving system are not continuously in use. To maintain dead oil in these sections in a fluid state required that they also be lagged with tubing for circulation of 200° F. water. The drain pit likewise is equipped with hot-water coils. Because of evident thermal expansion in blocked sections of the manifold, thermal relief valves are installed in these sections.

All manifold piping, including the prover tank, is covered with a 1-in. layer of glass fiber and insulating cements and canvas wrapping. This provides an insulation which will give maximum heat retention.

Proving system . . . The gravimetric proving system used was designed and installed in accordance with A.P.I.-A.S.M.E. Meter Code No. 1101. This system was considered by Union and Western Gulf to have precedence over volumetric types for the following reasons:

1. The high-viscosity characteristics of the crude will not allow the tanks to be completely emptied. Adherance of crude to walls of the vessel would result in considerable error if volumetric methods were used. This condition does not affect the weigh method.

2. Considerable temperature fluctuations can be anticipated in the prover tank and will likely result in volumetric inaccuracies where heated crude oil is handled. Temperature changes have no effect on the gravimetric system, except in the specific-gravity determination.

3. The weigh method can be more readily adapted to automatic proving equipment, and will produce printed weigh tickets. This reduces the possibility for human errors which sometimes occur in the reading of liquid levels.

UNION OIL COMPANY OF CALIFORNIA

Southern Division Pipe Line Dept.

Meter Calibration Report No.____
Gravimetric Method

Date_____ 19___ Location_____ Meter No. _____

Make and Size of Meter_____ Gallons Metered Since Last Proving_____

Type of Crude or Product_____

PROVER TANK MEASUREMENT DATA	RUN NO. 1	RUN NO. 2	RUN NO. 3	RUN NO. 4
(1) Rate, g.p.m.				
(2) Observed Specific Gravity				
(3) Observed Specific Gravity Temp. °F.				
(4) Corrected Specific Gravity at 60° F.				
(5) Equivalent °A.P.I. Gravity				
(6) Closing Scale Reading, Lb.				
(7) Opening Scale Readings, Lb.				
(8) Net Wt. Measured in Prover, Lb.				
(9) Conversion Factor, Lb./Gal.				
(10) Corr. Gal., Measured in Prover (8) ÷ (9)				
METERED VOLUME DATA				
(11) Line Press., psi.				
(12) Calibration Press., psi.				
(13) Line Temperature, °F.				
(14) Closing Meter Reading, Gal.				
(15) Opening Meter Reading, Gal.				
(16) Gallons Registered				
(17) Temperature Correction Factor				
(18) Net Gallons, Metered (16) x (17)				
(19) Meter Factor (10) ÷ (18)				

REMARKS:_____

(20) Average Meter Factor_____

(21) Meter Factor to be Used

Signed by:_____ Signed by:_____

For_____ For_____

Sheet No._____

METER CALIBRATION REPORT is a convenient form for step-by-step recording of the prover tank measurement data. Fig. 6.

Gravimetric-proving procedures . . . The meters are proved biweekly by use of the gravimetric-proving system in accordance with Code 1101. After more experience has been gained, it is not unlikely that the meters will be proved only monthly or even less frequently.

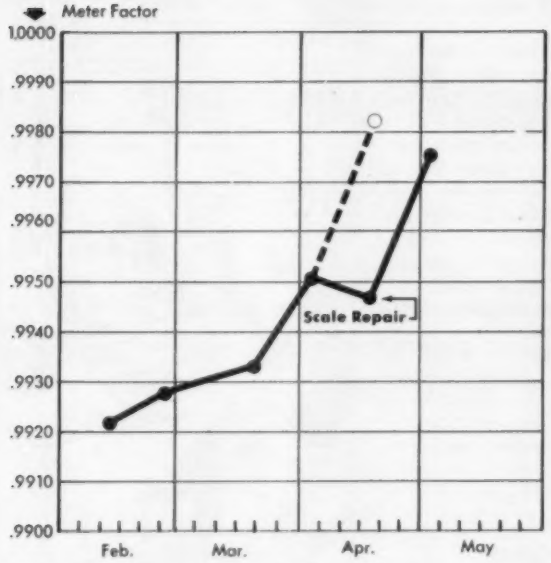
Prior to making the first run, the entire prover system is flushed with hot oil. Use of a three-way transflow valve allows the meters to be proved without stopping the shipping pump. A back-pressure regulator preset to actual pump discharge pressure, allows the check to be made under actual operating conditions.

The meters are equipped with dual counter-printer attachments. (See Fig. 1). One is used only when proving the meter. An electric remote-switching device provides push-button control for changing counters.

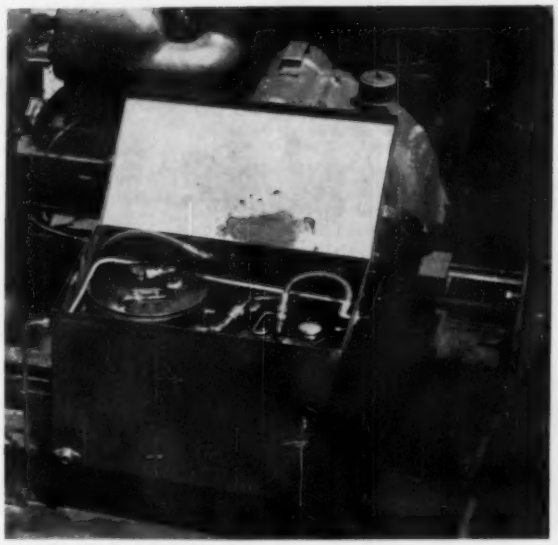
A meter ticket is inserted in the meter printer before starting the run. The reading as recorded on the counter totalizer is printed on the ticket as shown in Fig. 2.

A weigh ticket, shown in Fig. 3, also is inserted in the electric automatic printer attached to the scale. This device, shown in Fig. 4, allows remote printing of the weight as registered on the scale dial.

After about 15 gal. has entered the prover tank, the counter-switching button is depressed. The instant the counters are switched, an impulse actuates the printing on the scales automatic printing unit. This prints the tare reading on the weigh ticket. At this point



PLOTTER METER FACTORS obtained during recent months are shown here. Fig. 7.



PROPORTIONAL SAMPLE of 4 to 5 gal. is taken weekly into this sampling container. Fig. 8.

the opening meter reading and the tare scale reading have been simultaneously obtained.

After approximately 250 gal. has entered the prover tank, by meter reading, the counter-switching button again is depressed and another impulse actuates the scale-printing device. The gross weight in the prover and the closing meter reading now are printed on the weigh ticket. The closing meter reading likewise has been printed on the meter ticket. By turning the three-way valve, flow is diverted down the line.

At this phase, approximately 4 minutes have been consumed. The automatic temperature-recording instrument offers a permanent record of the line temperature during this interval. Flow rate through the meter at the time of proving was determined by use of a stop watch. All the data taken up to this time are recorded on the meter calibration report (Fig. 6).

. . . **Specific gravity** of the crude in the prover tank is determined from a 500-ml. representative sample withdrawn from the tank. The sample is placed in a controlled-temperature heating jacket located inside a liquid specific gravity, chainomatic balance (Fig. 5). Heat is applied to maintain a constant temperature comparable to the shipping temperature.

When the temperature remains constant for about 3 minutes, the observed specific gravity to the fourth place is read directly from the instrument's vernier scale. Temperature at which the observed specific gravity was taken is recorded and converted to specific gravity at 60°/60° F. by use of A.S.T.M.-I.P. Table No. 23. The specific gravity at 60°/60° F. then is converted to pounds per U. S. gallon at 60° F. by use of A.S.T.M.-I.P. Table No. 26.

These figures are recorded on the meter calibration report and are used to convert the weight, as registered on the scale, to gallons. The corrected gallonage as measured in the prover is divided by the net metered gallonage. The result is the meter factor.

Two or three subsequent provings are made in exactly the same manner. Results from these runs should not differ more than 0.0005.

Meter factors . . . The plotted meter factors obtained during recent months are shown in Fig. 7. They indicate very consistent results. With more experience, improved techniques will be adopted which will improve meter-factor accuracy. The meters produce results which are accurate to 0.05 per cent.

The specific-gravity reading is the most critical measurement, and the most difficult to obtain, in the gravimetric system of proving. Temperature control during the determination cannot be overemphasized. To determine the temperature for the reading, the recently developed thermistor thermometer is used. This instrument responds immediately to temperature change. This helps to reduce inaccuracies which are inherent in a chemical thermometer because of time lag.

It takes about 40 minutes to make the four test runs normally required.

Automatic line sampling . . . Obtaining a representative sample of the oil moving through the line is extremely critical in A.C.T. systems. This sample is of the utmost importance, since the quality of the oil and its subsequent value is determined from the field gager's laboratory tests on the sample. The system installed at Yorba Linda gives a continuous proportional sample which experience has shown to be accurate and representative of the oil shipped.

A 4 to 5-gal. proportional sample is taken weekly by adapting the stroke of a chemical feeder pump to the reciprocating rod of the shipping pump. As the pump strokes, a small amount of oil is forced from the sampling line into a 5-gal. sampling container (Fig. 8). This results in a sample directly proportional to the flow of oil through the shipping pump.

To obtain a sample representative of the fluid moving through the line, it was necessary to create turbulent flow conditions ahead of the sampling probe. This was done by using an orifice plate containing a 3-in.-diameter star-shaped hole in the center. This is inserted 6 in. (one pipe diameter) upstream from the probe, which extends to the center of the star opening.

To effectively move the highly viscous crude to the sampling unit, 1-hp. electric-motor-driven gear pumps are used. These circulate the crude to the samplers at velocities equal to or slightly higher than the velocity of the movement through the 6-in. suction line. A ¼-in. probe, extending to the midpoint of the 1-in. line, is used to obtain the samples. The sam-

APPENDIX — EQUIPMENT USED IN YORBA LINDA A.C.T. SYSTEM

2—3-in., Series 150, Brodie BiRotor, B-62-D meters, with dual Brodamatic counter and printer equipped with electric remote shifting device and counters to read in gallons; equipped with totalizers.

2—4-in., Series 150, Brodie D-64 strainers with 20-mesh screens.

1—Floco gravity-type meter prover, which includes one Fairbanks-Morse Code 12144, heavy-duty, 5,000-lb. scale, installed with 48-in. by 48-in. platform. Equipped with CA cabinet dial, 3,000-lb. by ½-lb. chart capacity with tare beam of 500 by 100 and 125 by ½-lb. scale. Complete with one Code 12047 Printomatic with single ticket slot, gross net and tare, electric remote printing; and one 350-gal. cone-bottom prover tank, 54-in. high by 42-in. diameter; over-all height, including legs, 82-in.; working capacity, 300 gal.; insulated.

1—Christian Becker Model SG-1, liquid specific-gravity, chainomatic, direct-reading balance.

2—Mason-Neilan temperature recorders—Model 63010, 0°-200° F.

1—Mason-Neilan 1-in. pressure controller, 60 to 360 psi.

1—Yellow Springs Instrument Co., Inc. Tele-Thermistor thermometer, Model 430, for 60°-212° F. range; complete with special 2-in. probe.

1—Gaso 4½ by 6-in. duplex pump, with 30-hp. gas-engine drive; skid mounted.

2—Manzell chemical pumps, for sampling.

2—¾-in. Roper gear pumps with 1-hp. motor.

pling lines are lagged with copper tubing and insulated in the same manner as the larger lines.

Results obtained from the automatically procured weekly line samples compare very favorably with those obtained from a proportional composite tank sample taken over the same period of time.

Operational advantages . . . To date very few operational problems have turned up, and even those have been unimportant. Experience with the A.C.T. system, however, has shown it to have the following advantages:

1. The producing-company storage requirements are reduced approximately 50 per cent, thereby realizing a substantial saving in capital expenditure. From the producer's standpoint, this low-gravity crude requires heat and retention time to obtain merchantable oil, and most of the storage is required for this phase of the operation.

2. Eliminate close water drains and topping of tanks.

3. Reduces appreciably the time normally required at the tank for gaging and sampling. Union's gager spends approximately 20 minutes at a conventional lease tank battery, as compared to about 5 minutes at the A.C.T. installation.

4. Continuous operation of the system affords reduced equipment maintenance, since over-all operating pressures are held to a minimum.

5. Continuous operation, particularly when handling heavy viscous crudes, permits installation of smaller size equipment and pipelines, thereby reducing capital investment.

6. Pipeline receipt tickets are reduced from 30 to approximately 4 per month. This reduces lease accounting costs considerably.

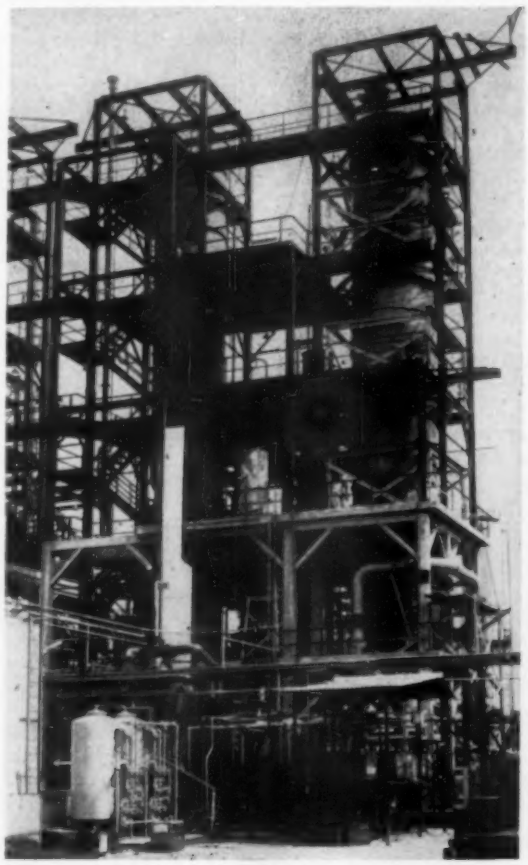
7. Continuous operation results in a more uniform pipeline mixture which may be highly desirable if blending procedures are practiced.

8. Continuous operation decreases pipeline deposition, thereby minimizing down time normally required for scraping.

Acknowledgment

Appreciation is expressed to D. A. Smith, Union Oil Co. pipeline engineer, for supplying all information for this article, and to both Union and Western Gulf Oil Co. for permitting it to be published. **End.**

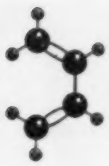
"Now, boys, you've got something that will really sell gasoline."



Expanded synthetic methanol

purification facilities are now on stream at the Sterling, La., petrochemical plant of Commercial Solvents Corp. The job was engineered by Badger Manufacturing Co., of Cambridge, Mass., using a new process for producing extra high purity methanol.

Commercial Solvents produces pure synthetic methanol from natural gas and air and refines the crude methanol by special distillation techniques so that no chemical treatment is involved in the process.



MAKING BUTADIENE—2

Butylene Dehydrogenation by the steam-dilution method

This is today's basic method for commercial production of butadiene from butylenes. But different results may be obtained with different catalysts. Currently there is great activity in catalyst development, some of which is reported here.

By John C. Reidel
Petrochemical Editor

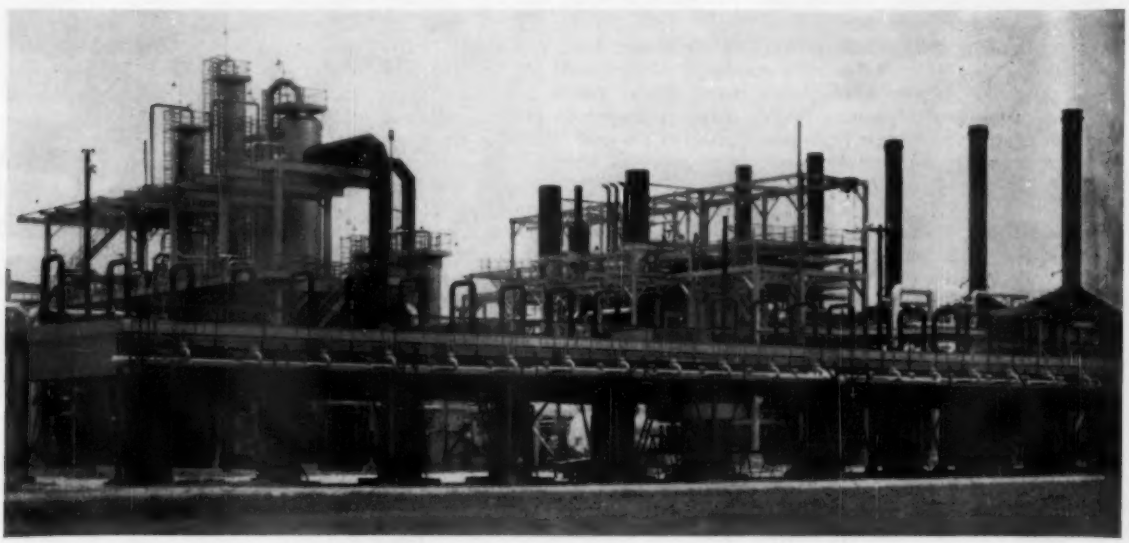
EACH of the catalysts employed for butylene dehydrogenation has somewhat different characteristics, requires different operating conditions, and yields product and byproducts in somewhat different ratios. It is also recognized that the U. S. Patent Office grants "process" patents for certain catalyst developments. However, it does not seem that any of the presently employed catalysts alters the basic principle of the steam-dilution process. Therefore, in the discussion of this process which follows, it will be treated as a single process although it is understood that different results are obtained with the various catalysts.

It also must be emphasized that in a report such as this no attempt can be made to generalize on the choice of catalyst. There are too many ramifications, too many overlapping factors involved. In addition to such factors as maximum selectivity and regeneration, still other factors require consideration. For example, hygroscopicity of the catalyst can be an important factor for plants located in the moist Gulf Coast climate. Choice of catalyst depends on the particular installation and its individual requirements.

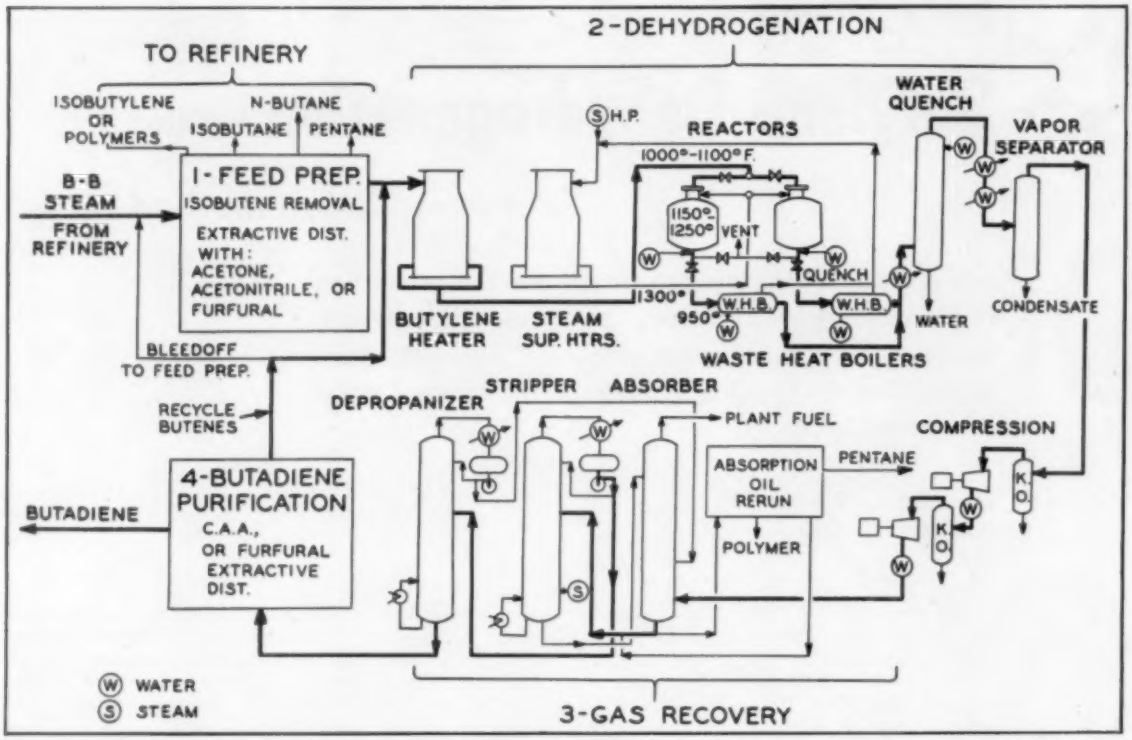
Today's Processing

Existing commercial processes for butadiene manufacture include: (1) butylene dehydrogenation by the steam-dilution method, (2) butane dehydrogenation by Houdry one-step, and (3) butane dehydrogenation by Phillips two-stage. A fourth source is byproduct butadiene obtained in high-temperature cracking for ethylene manufacture.

Ethylene byproduct . . . Butadiene as byproduct from ethylene manufacture continues to be a minor source today relative to butane and/or butylene dehydrogenation. Figures were given in Table 1 (in Part 1 of this series) for the production from this source by Allied Chemical & Dye, Dow Chemical, Esso Standard, and Union Car-



NEW STEAM-DILUTION UNIT of Humble Oil & Refining Co. at Baytown is used for butylenes dehydrogenation. Humble completed butadiene expansion in 1957, from 49,000 to 65,000 tons per year.



TYPICAL DEHYDROGENATION and gas-recovery sections when using the steam-dilution process to make butadiene from butylenes. Fig. 1.

bide Chemicals. Butadiene as byproduct from ethylene cracking amounts to roughly 10 per cent of the United States petroleum-derived butadiene capacity, as noted previously.

Dow, at Freeport, Tex., uses butadiene for preparation of styrene-butadiene latices, which are also made at Midland and elsewhere. Most of Union Carbide's butadiene from Texas City and Seadrift, Tex., goes to the Du Pont Victoria plant where it is used for making adiponitrile (nylon salt basic).

Borrows and Seddon[4] have examined the problem of separating butadiene in a C_4 stream from high-temperature cracking, containing 15 per cent by weight of butadiene. They proposed the use of furfural extractive distillation which is more suitable for this lower concentration than azeotropic distillation with ammonia as used by Dow Chemical during wartime[3] for a stream containing some 50 per cent of butadiene.

Dehydrogenation

Butylene and butane dehydrogenation are similar in many respects. No attempt is made here to cover the thermodynamics of the reactions, since this has been done elsewhere (see references). However, the major points concerning these reactions will be noted briefly.

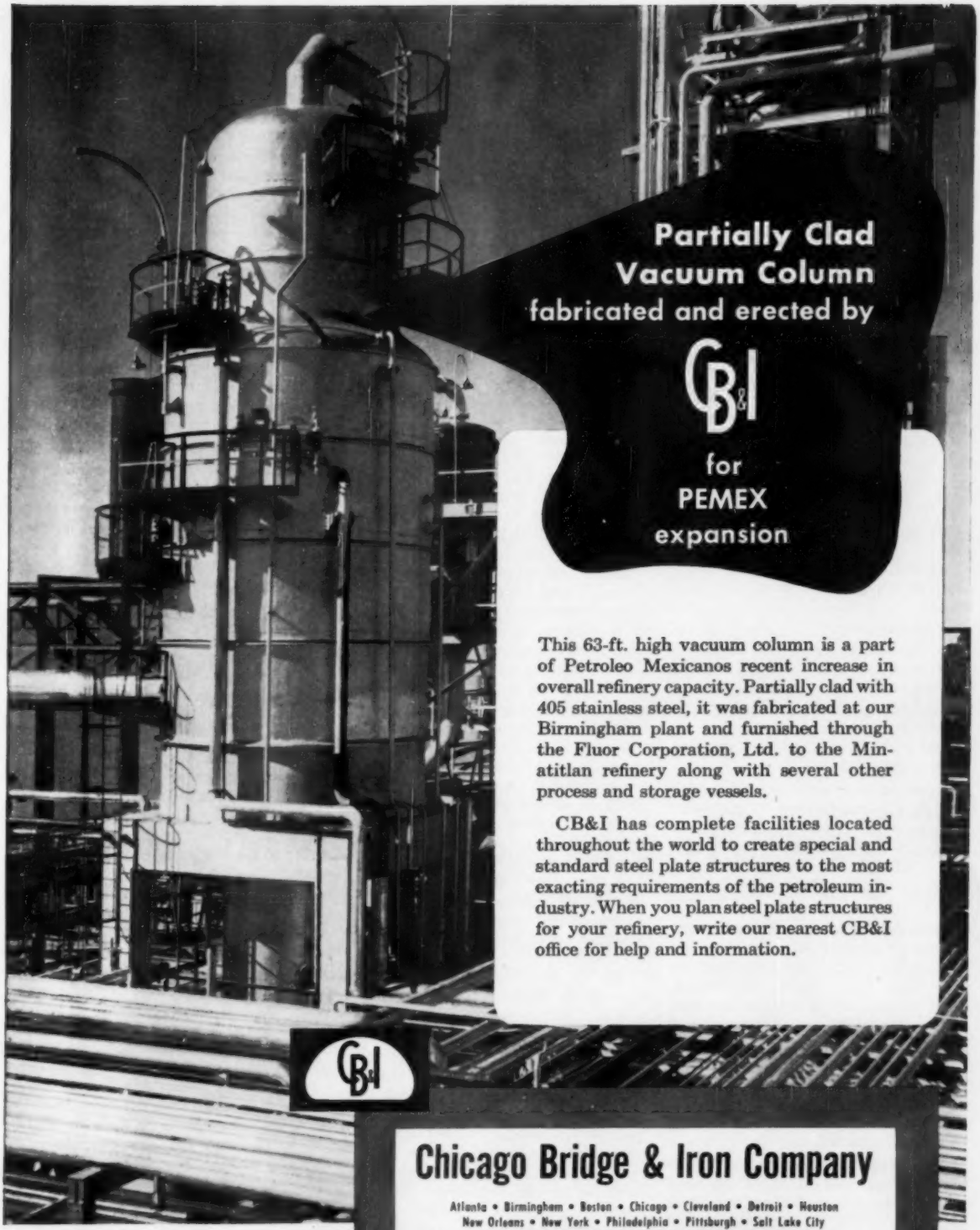
1. Heat requirements . . . Both butylene and butane dehydrogenation are **highly endothermic.** Heat requirements are some 1,000 B.t.u. per pound of butadiene or per pound of butylene formed, when going from butylene to butadiene or from butane to butylene, respectively; when going from butane to butadiene directly the requirements are then about 2,000 B.t.u. per pound of butadiene formed.

2. Residence time . . . Both dehydrogenations could be carried out over similar (chromia-alumina type) catalysts, though in practice different catalysts are used, except in the Houdry process. The catalyst must be strongly **selective** — it must speed up the dehydrogenation reaction relative to the noncatalytic thermal decomposition (carbon-chain rupture) reactions. This raises the question of proper **contact time.** Contact with catalyst should be long enough to give a nearly equilibrium mixture, but not so long as to permit the carbon-chain splitting reactions to predominate.

3. Other conditions . . . For butylene dehydrogenation the desired equilibrium mixture is formed at a higher temperature than for butane dehydrogenation. Therefore the former reaction is conducted in the broad range of 1,000°-1,300° F. and the latter in the range of 900°-1,100° F. The upper limit for butylene dehydrogenation is set at around 1,300° F. in order to minimize cracking of butylenes, coking, thermal polymerization, and ultimate decomposition of the butadiene that is formed. Similar considerations hold when dehydrogenating butane to butylenes. If too high a temperature or pressure is used the butylenes that have been formed are destroyed, with ultimate formation of tars and carbon. Too high a pressure also reduces the equilibrium butylene concentration and thus lowers the butane utilization.

4. Regeneration . . . In commercial practice some formation of carbonaceous deposits has been unavoidable and catalyst regeneration in one form or another has been required. One catalyst now in commercial use is stated to have had a run of over a year without any regeneration whatsoever. Other catalysts, used in the steam-dilution method, are kept nearly clean by the steam during reaction and require regeneration for an hour or two during each 24-hour operating period. Some plants regenerate for only 1 hour during each 48 hours of operation.

5. Reactor design problems . . . To summarize, the two major problems



Partially Clad Vacuum Column fabricated and erected by CB&I for PEMEX expansion

This 63-ft. high vacuum column is a part of Petroleo Mexicanos recent increase in overall refinery capacity. Partially clad with 405 stainless steel, it was fabricated at our Birmingham plant and furnished through the Fluor Corporation, Ltd. to the Minatitlan refinery along with several other process and storage vessels.

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Above: 63-ft. high vacuum column partially clad with 405 stainless steel built by CB&I for Petroleo Mexicanos Minatitlan refinery.

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in reactor design are: (a) heat supply and (b) residence time. Large quantities of heat must be supplied at a high temperature in a very short (say in the order of 0.2-0.4 second) contact time. The ideal reactor would be an **isothermal** one. But this poses a difficult heat-transfer problem involving a large number of small-diameter tubes filled with catalyst. However, Phillips chose such a process for the first stage of its two-stage dehydrogenation of butane. Standard Oil Development Co. (Esso) developed the steam-dilution **(adiabatic)** method in which heat for the butylene dehydrogenation is supplied by superheated steam. Phillips also employs steam for its second-stage (butylene) dehydrogenation. Houdry, in its one-step dehydrogenation of butane went to an **adiabatic** reactor, in which an inert material in the catalyst bed stores the heat liberated during regeneration and then gives it up during reaction.

Steam-Dilution Method

Standard Oil Development Co. investigated both one-step and two-step butane dehydrogenation. However, catalytic cracking provided large quantities of cheap butylenes. Standard then turned to this feed and evolved the steam-dilution method (references 5, 6, 7, 8, 9). Shell came along and provided a superior catalyst that required a relatively minimum regeneration time.

Note: It is a moot point whether to call this method an "Esso type" process or a "Shell" process. Many operators refer to their steam-dilution facilities, employing Shell catalyst, as "Shell" units.

Process description . . . Major features of the steam-dilution process are indicated in Fig. 1 which is a simplified flow sheet for a typical installation. Feed preparation includes isobutylene removal by cold acid treatment followed by separation of normal butylenes from butanes by extractive distillation to produce a butylene concentrate of some 80-85 per cent n-butylenes which constitute the feed to dehydrogenation.

This butylene stream plus recycle butenes from the butadiene recovery and purification section are preheated to about 1,100° F. The butenes are mixed with superheated steam by jet-type mixers located directly above the catalyst bed and discharging downward onto the bed.

A typical once-through yield for the steam-dilution process when using Shell catalyst may be given in Table 2 (figures are in weight per cent):

TABLE 2

Butadiene Production, Once-Through Yields (Steam-Dilution Method)

	Feed	Product
N-butenes	80.0	60.0
Butadiene	2.0	16.4
Other C_4's	18.0	16.0
Polymer	...	1.0
Gas and Coke	...	6.6

Quenching reduces the temperature of the gas mixture to below 1,000° F. Following the quench, reactor effluent is cooled through waste-heat boilers in which process steam is generated. Further cooling is accomplished by water and/or oil quench in quench towers, and in shell-and-tube or other equipment to condense the steam. The condensate is removed in the vapor separator and uncondensed hydrocarbon vapors go to the compression and gas-recovery sections.

Conventional oil absorption is indicated for the gas-recovery section of Fig. 1. The C_4 hydrocarbons and some of the C_3's are absorbed. The absorber offgas, consisting largely of hydrogen and C_3's and lighter and some CO_2, goes to plant fuel. (This hydrogen-rich stream could be used to supplement hydrogen feed for ammonia manufacture as will be done by Petroleum Chemicals, Inc., at Lake Charles.) A slipstream of the absorption oil goes to the absorption-oil rerun system for removal of polymers which have built up during processing. After the stripping step, the C_3's, with some C_4's, are removed overhead from the depropanizer and returned to the absorber. (An auxiliary absorber could be added at this point to recover a separate propane-propylene stream if desired and warranted by the stream composition.)

A somewhat different gas-recovery scheme was included in the Baton Rouge plant described by Russell, Murphee, and Asbury[5] and reviewed by Gilliland.[9]

The C_4 concentrate from the bottom of the depropanizer, containing perhaps 18-20 per cent butadiene, then goes to butadiene recovery and purification. This, too, will be discussed in more detail later. Unconverted butene-2's and butene-1 are separated from the butadiene, and the butadiene is rerun to meet purity specifications of 98 per cent or better. A small portion of the recycle butenes from the butadiene-recovery-and-purification section is returned to the feed-preparation section to control buildup of diluents—butanes and isobutene—in the reactor feed.

What the steam does . . . The steam is a heat carrier, permitting adiabatic operation with a relatively shallow catalyst bed and small temperature drop (say 50°-75° F.) over the bed. At the same time steam dilution reduces residence time since a large volume of butene-steam mix goes through the reactor per unit time. This then takes care of the two prime problems noted above—heat supply and residence time.

In addition, the size of the butene preheater can be reduced. (Butenes are preheated to a lower temperature minimizing the possibility of cracking.) Partial pressure of the butenes is reduced by mixing with steam and this helps to suppress side reactions leading to excessive byproduct gas and carbon formation. With Shell catalyst, the steam removes some of the coke deposited on the catalyst. This is accomplished even during the onstream period by the water-gas reaction which is catalyzed by the Shell catalyst.

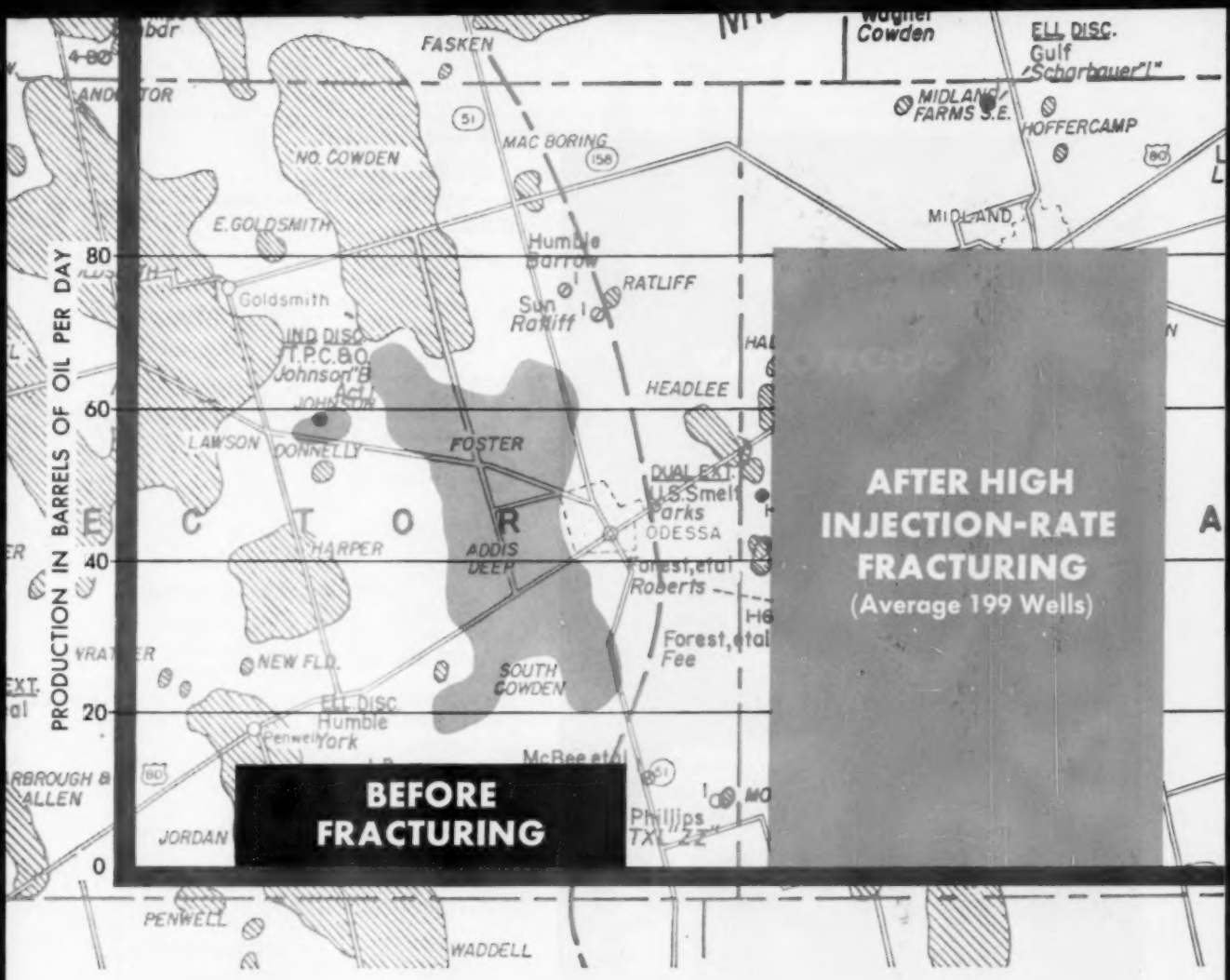
Apparently, removal of coke by the steam during dehydrogenation may be even more marked in the case of the 1490 catalyst recently developed by Phillips Chemical Co. Phillips states that commercial experience with this catalyst at Borger in more than 1 year's operation has shown that no regeneration is required for the 1490.

Catalyst . . . Butylene utilization with chromia-alumina catalyst in the presence of steam is low, amounting to only 30-40 mole per cent. To make the steam dilution method practical the "1707" catalyst was developed during wartime to give 20-40 mole per cent conversion at selectivities of 70 or more per cent in presence of steam. This catalyst contained ferric oxide as the active ingredient, with other oxides—K_2O, some cupric oxide and M_gO—for promotion and stabilization. Later this was supplanted by the Shell 105 catalyst and this in turn was largely superseded by the Shell 205 catalyst. This latter permits use of a lower steam/butene ratio. With the older 1707 catalyst regeneration was required on a cycle of 1 hour reaction and 1 hour regeneration. In current practice with Shell catalysts the normal regeneration time is of approximately 1-hour duration in each 24-hour operating period.

Today all plants (with the exception of Sarnia and the new portion of Neches Butane using Dow Type B catalyst, and of Phillips which has developed its own 1490 catalyst) use Shell 105 or Shell 205 catalyst for which bed depths have been limited to 32 to 36 in. Greater depths (about twice as deep) are required for Dow catalyst.

Developments in Catalysts

First commercial use of the Dow Type B catalyst was at the Sarnia,



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a 523% increase in production with Dowell high-injection-rate fracturing

A 523 per cent average increase in production resulted when 199 wells in the Grayburg limestone of West Texas' Johnson-Foster-South Cowden Field were given high-injection-rate fracturing treatments by Dowell. Average well potential jumped from 13 barrels per day to 81 when wells were treated with Sandfrac®, using an average of 20,000 gallons of refined oil and 40,000 pounds of sand per well.

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Many of these wells were old and had been given a variety of earlier treatments, including shooting and acidizing.

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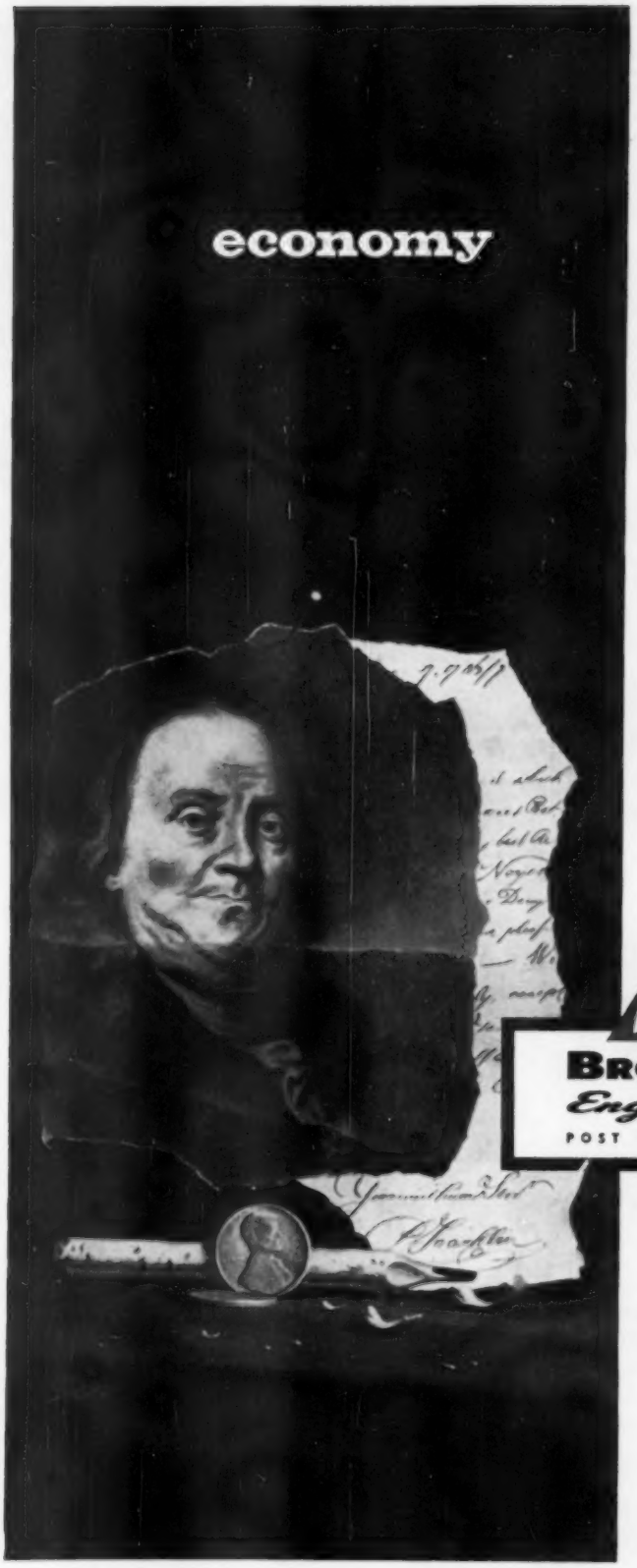

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TABLE 3 — EXISTING COMMERCIAL PROCESSES— BUTYLENE DEHYDROGENATION (STEAM DILUTION)

	A. ISOBUTYLENE REMOVAL	B. SEPARATION OF BUTYLENES FROM BUTANES
1. FEED PREPARATION	Cold acid polymerization —65% H_2SO_4	Extractive distillation with: 1. Acetone 2. Acetonitrile* 3. Furfural †

	SHELL CATALYST 205	DOW TYPE B CATALYST
2. CATALYTIC DEHYDROGENATION (Bed type reactor—steam dilution method—adiabatic)	CONVERSION‡: 26-28 mole per cent per pass SELECTIVITY§: 73-75 mole per cent SPACE VELOCITY¶: 500 V/V/H TEMPERATURE: 1,150°-1,250° F. PRESSURE: Above bed 7-11 psig.; below bed 2-4 psig.; partial press. at reactor inlet 60-80 mm. Hg. STEAM/BUTENE gas vol. ratio:** 8:1 REGENERATION: With steam, approx. one hour in each 24-hour operating period.	CONVERSION: 45-55 mole per cent SELECTIVITY: 90 mole per cent and higher. SPACE VELOCITY: 100-200 V/V/H TEMPERATURE: 1,100°-1,250° F. (mixed feed temp.) PRESSURE: 10-15 psig. (above bed) STEAM/BUTENE ratio: 18-20:1 REGENERATION: Requires regeneration with air and steam; regeneration frequency: 10-60 minutes.
3. GAS RECOVERY	Conventional oil absorption.	
4. BUTADIENE FINISHING Separation of butadiene from unconverted butenes	Solvent extraction with cuprous ammonium acetate.	or Extractive distillation with furfural.

*Employed by Shell at Torrance.

†In plants employing furfural, the furfural extractive distillation is used in both feed preparation (butylenes concentration) and in butadiene finishing.

‡CONVERSION is the number of pounds (or moles) of n-butenes disappearing per pass per 100 pounds (or moles) of n-butenes feed.

§SELECTIVITY is the number of moles of butadiene produced per 100 moles of n-butenes converted.

¶SPACE VELOCITY is volume of n-butenes (at 60° F., 760 mm. Hg.) per volume of catalyst per hour. Space velocity varies with catalyst and plant facilities (chiefly compression). In some cases higher velocities, such as given here for Shell 205 catalyst, may be advantageous in their effect on conversion and selectivity.

**Shell normally uses a steam dilution ratio of 8/1; at times a higher ratio (12/1) may be used. Others may use still higher ratio, which may be attributed to differences in catalyst.

Ont., plant of Polymer Corp. Later Humble at Baytown and Phillips at Borger made some experimental and commercial runs with it. At the present time Neches Butane will employ Dow catalyst for the new portion of its expanded facilities, but continues to use Shell catalyst in existing units. Recently Esso Research & Engineering signed a license agreement; plans are to use Dow catalyst at the new Esso Petroleum, Ltd., butadiene facilities at Fawley, England, which are due to be completed in 1958. (Esso has also licensed the Houdry process.)

Development of the Dow Type B catalyst for making butadiene from butylenes resulted from Dow's interest in butadiene manufacture dating back to the early '40s. Britton, Dietzler, and Noddings[10] describe it as being a calcium-nickel phosphate promoted with 2 per cent of chromium sesquioxide. Results of laboratory dehydrogenations are given by these authors. Reilly[11] has discussed the problems encountered in commercial application of this catalyst at Sarnia and the measures taken to overcome these difficulties. The first commercial run with Type B catalyst was made at Sarnia in 1945. Metallic nickel and Ni alloys were found to be strong poisons for this catalyst. Steam/hydrocarbon ratios of 18-21 were required for smooth operation and higher selectivity. This was followed by successful semicommercial and large-scale runs. Polymer Corp. switched to full commercial use of Dow catalyst in 1951.

On the basis of this Sarnia experience Reilly[11] compared the Dow Type B catalyst with the Shell 105. This comparison should be updated by comparing with Shell 205 rather than the Shell 105 catalyst; but some

Congrats and $25 to James Barr, P. O. Box 201, Lafayette, Louisiana, Sperry-Sun Well Surveying, for this quip.

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idea can be obtained as to the advantages and disadvantages of the Dow catalyst. Other credits and debits for this catalyst are listed by Noddings, Heath, and Corey.[12]

Though the Sarnia facilities had switched to full production with the Type B catalyst in 1951, efforts to convert plants of the U. S. Government-owned butadiene industry were not successful. By 1955 laboratory development of the Type B catalyst apparently indicated that still higher conversions per pass were possible for sustained periods at the usual high selectivity.[13] It should be noted that Polymer Corp.'s most recent data are confidential, being released only to licensees. Meanwhile Dow has built a semicommercial dehydrogenation unit at Freeport, which has now been running for some 6 months, for further experimental work with its catalyst.

Table 3 summarizes the steps in preparation of butadiene from butylenes when employing the steam-dilution method. Summary of conditions is given when using Shell 205 catalyst and also when using Dow Type B catalyst. A similar summary when using Phillips 1490 catalyst for butylene dehydrogenation is included in Table 6 which is presented in the next section of this report.

Whether one selects the Shell 205 or the Dow Type B catalyst or the Phillips 1490 depends on the particular plant conditions and the economics dictated thereby.

It is known that companies engaged in butadiene manufacture are individually working hard to improve catalysts. We might expect more interesting developments in the field of catalysts.

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Butylene Dehydrogenation—Steam Dilution Process

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Dow Catalyst

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11. P. M. Reilly, "Commercial Development of Dow Type B Dehydrogenation Catalyst," Chemistry in Canada, March 1953 (from second regional conference, Chemical Institute of Canada, March 3-4, 1953 at Hamilton, Ont.).

12. C. R. Noddings, S. B. Heath and J. W. Corey, "Conservation of Butylenes in Butadiene Manufacture," Symposium on Petrochemicals, American Chemical Society, September 6-11, 1953 at Chicago.

13. Personal comunication, Dow Chemical Co., technical service department.

BOOKS

PHASE RELATIONS OF GAS CONDENSATE FLUIDS by C. Kenneth Eilarts and others. Vol. 1 of two volumes, Test Results, Apparatus, and Techniques. Published by the American Gas Association, 420 Lexington Avenue, New York 17, N. Y. 439 pp. $10.

This volume describing fundamental research conducted by the Bureau of Mines, USDI, in cooperation with the American Gas Association culminates 20 years of study of fluids and high-pressure reservoirs.

It contains 201 illustrations, 106 tables, and over 200,000 words of text. Fundamentals are reviewed in one of the eight chapters, test results are reported in five of the chapters, and two chapters are devoted to correlations. Vol. 2 now in preparation will pertain to correlations of test results.

Gas-condensate fluids represent one-fourth to one-third of the reserves of natural gas in the United States. The critical temperature of fluid recovered from these reserves is lower than reservoir temperature, and liquid gravity generally lighter than 48° A.P.I. is condensed from the fluids as pressure is decreased at reservoir temperatures.

This volume contains some of the results of two decades of research on the effect of pressure and temperature on the liquid-gas ratio and compressor-gas ability of these fluids. This information has been used to prepare 24 correlations which can be applied to reserve estimates and engineering problems of recovery.

Experimental investigations have been made with equilibrium cells to measure liquid-gas ratios and specific volumes of gas-condensate fluids in the temperature range —100° to 280° F. at temperatures up to 6,000 psia. Mobile equipment had been used at flowing wells in the field to determine the phase diagram of eight gas-condensate fluids, and especial attention was given to the measurement of dew-point pressures.

The results of these investigations are reported, as is information concerning techniques of measurement and accuracy of the test results.

UNIT OPERATIONS OF CHEMICAL ENGINEERING, by Warren L. McCabe and Julian C. Smith. Published by McGraw-Hill Book Co., Inc., 330 W. Forty-second Street, New York 36, N. Y. 945 pp. $10.50.

This book is written for junior and senior undergraduate students in chemical engineering and covers unit operations from both a practical and theoretical standpoint at a uniform level of treatment. Each unit operation is treated separately.

The approach to the basic operation of fluid flow differs from conventional chemical-engineering treatments. This subject has been renamed fluid mechanics and the boundary layer concept is introduced early and used throughout the chapter.

The theory of diffusion is based on the relative velocity method and the problem of direction of diffusion and number of diffusing components is handled in a simplified and general manner. The Drew-Colburn mass-transfer coefficient is used throughout.

The book includes 113 worked-out examples, nearly 150 unsolved problems, 500 figures, and 275 references to the chemical engineering literature. The nomenclature throughout is uniform and tables and symbols are given at the end of each chapter.

Note: The Oil and Gas Journal maintains a book department. Write to the READER SERVICE DEPARTMENT, P. O. Box 1260, Tulsa 1, for copies of the book list. Often books reviewed here may be purchased from this source.

Nelson Refinery Construction Index

Appears in the Engineering Section in the first issue each month.
Compiled by W. L. Nelson, petroleum refinery consultant, Tulsa.

The Index was explained October 1, 1956 (page 110), as well as the Indexes of Individual Items of Equipment that appear on the COST-imating page in the first issue of the months of January, April, July, and October.

Index (1946 = 100)

	1949	1952	1954	1955	1956	Aug. 1957
Pumps, compressors, etc.	135.9	155.6	166.5	172.2	192.0	207.1
Electrical machinery	130.9	152.4	160.0	162.5	175.0	189.5
Internal-combustion engines	124.8	146.5	150.5	153.2	164.0	174.4
Instruments	123.1	146.2	154.6	162.9	182.1	186.2
Heat exchangers	133.0	165.8	171.7	156.8	190.7	203.4
Miscellaneous equipment average	*121.6	153.3	160.7	161.5	180.5	192.1
Materials component	143.6	164.3	174.6	176.1	190.4	205.4
Labor component	137.1	163.1	183.3	189.6	198.2	212.4
Nelson construction index	139.7	163.6	179.8	184.2	195.3	209.6

*Used in computing the Nelson Index until April 1952. This is slightly different from the average of the Miscellaneous Equipment Items shown above.

How Humble plans to control

15,000-Psi. Well Pressures

Wellheads, christmas trees, and tubing equipment for the 16,000-plus-foot wells now being drilled on the Gulf Coast are a must, and may be needed in abnormal-pressure areas when the well goes below 12,000 ft.

By C. A. Dunlop and T. V. Miller
Humble Oil & Refining Co.

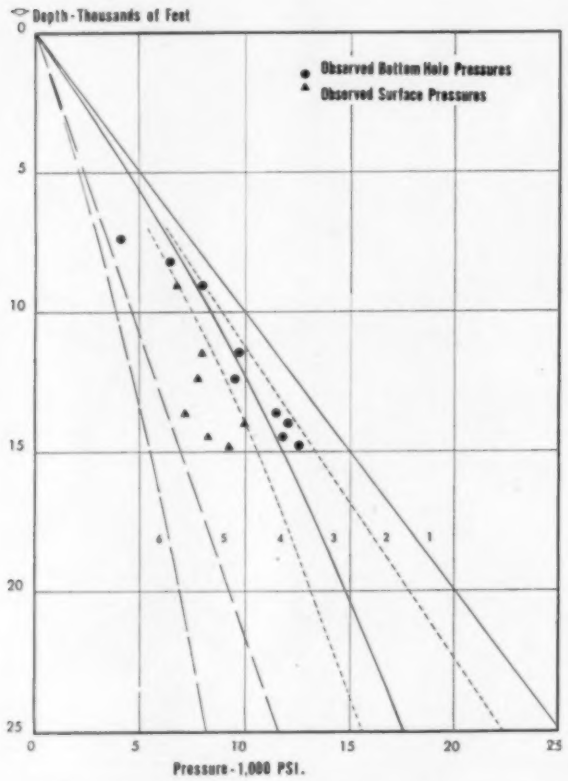
WELLS DRILLED below 12,000 to 14,000 ft. may be expected in some cases to have surface pressures exceeding 10,000 psi. This is particularly true in areas such as the Gulf Coast where the deeper wells frequently hit abnormal pressure formations, as shown in Fig. 1.

Paper presented at petroleum-mechanical conference, ASME, Tulsa.

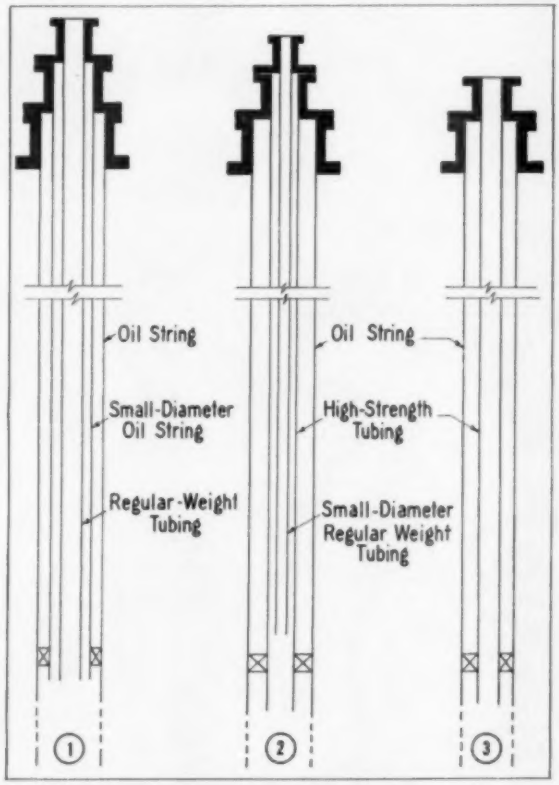
The number of 10,000-ft. and deeper wells to be drilled during the next decade in the California and Gulf Coast regions will increase from approximately 2,400 per year to more than 4,000 per year. Also, during the period, the number of deeper wells (those below 16,000 ft.) will increase from about 70 per year to about 330 per year.

It is seen, then, there is now a definite need for 15,000-psi. equipment, and that this need will increase with deeper drilling.

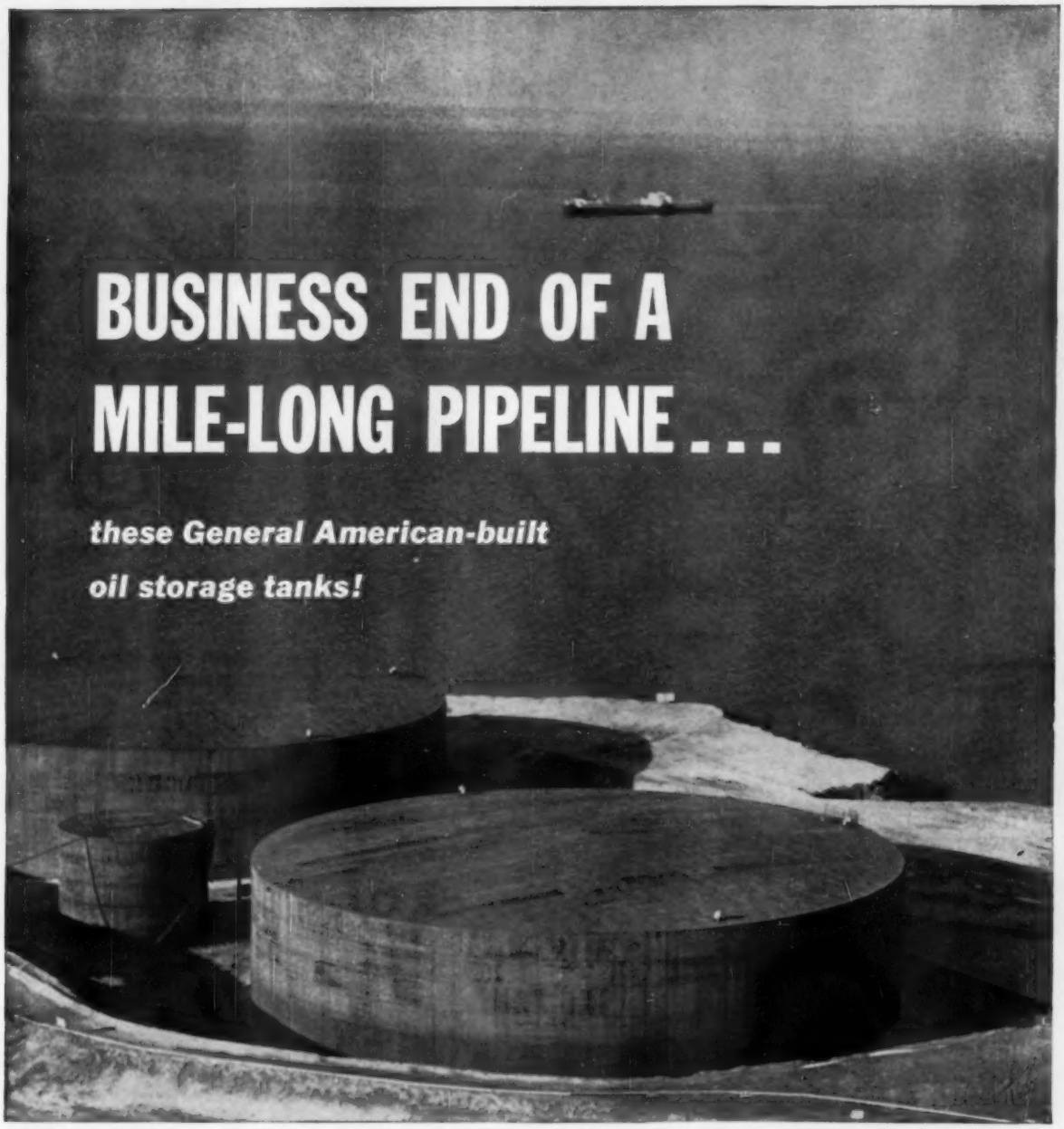
Testing equipment . . . When a 10,000-psi. shut-in pressure was encountered in a well in 1952, a research project was established to develop and test 15,000-psi.-w.p. equipment. As gas



ABNORMAL BOTTOM-HOLE and surface pressures encountered in the Gulf Coast area. Fig. 1.



THREE GENERAL COMPLETION METHODS are used for extremely high-pressure wells as shown here. Fig. 2.



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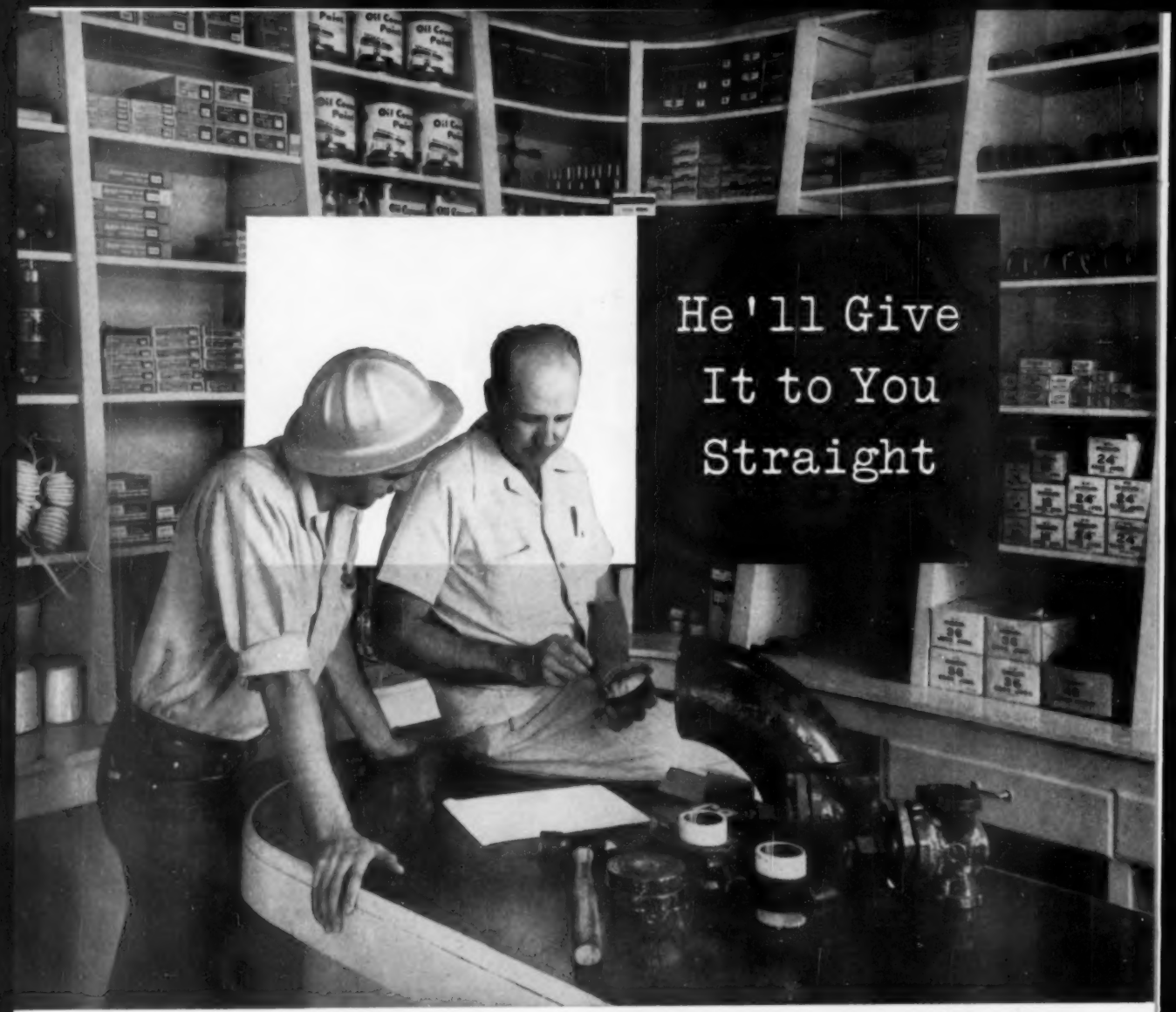

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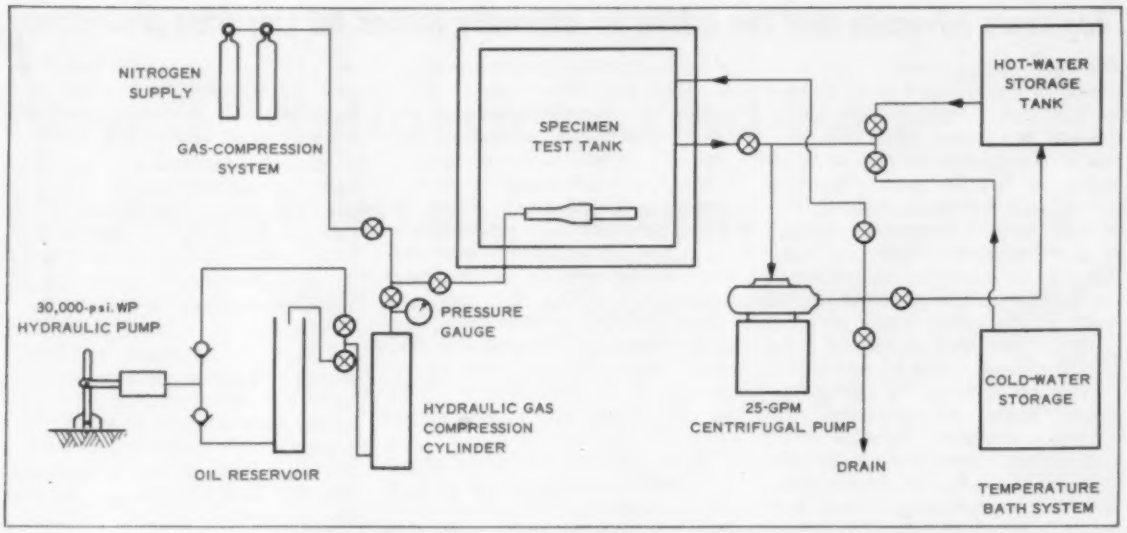


SYSTEM FOR TESTING 15,000-psi.-working-pressure equipment. Fig. 3.

and gas-condensate were the media anticipated to be encountered at these high pressures, testing equipment was designed to use dry nitrogen gas as a testing medium. To provide for thermal changes that occur in a well, equipment was selected to provide for changing the temperature of test samples. This type of test causes a change in pressure of the gas entrapped in the specimen and is believed to be more strenuous than merely using a liquid at high static pressure.

Fig. 3 is a schematic diagram of the system. A metal box, for submerging the test samples in hot and cold water, is jacketed with a thick layer of protective sand and has shatterproof glass observation windows at the top. An electrically driven hydraulic, gas-compression pump mounted on a rigid cast-iron base with an oil reservoir and gas-compression cylinder is capable of operating at 30,000-psi. maximum working pressure.

The test samples and the compression cylinder are charged with 1,500 to 2,000-psi. bottled nitrogen gas, and the desired testing pressure is obtained by hydraulically compressing the gas in the compression cylinder. A gas-operated hot-water heater is used to obtain temperatures of the bath water in the tank of approximately 175° F., and normal city-water-supply temperature of approximately 75° F. is used on the cool side of the cycle. Bath changes are accomplished by means of a water-circulating pump.

Test methods . . . Samples are prepared for testing by welding plugs, tapped for a gage or fitting, in the plain ends. The threads of all tubing joints are inspected for accuracy and finished to insure tolerances within limits on individual elements and standoff. The joints are then gripped in a buck-on machine and made up in a manner recommended by the manufacturer or, in the case of API joints, to 1,500 ft.-lb. of torque with a minimum of 1½ turns of make-up from handtight position for 2-in. tubing, and 2,000 ft.-lb. and 1¾ turns of makeup for 2½-in. tubing.

Thread turns from handtight position and torque developed are observed. Filler bars are placed in the specimens prior to being made up to reduce the gas volume to be compressed. The test samples are filled with a solution of fluorescent dye and detergent in water and are placed in the test tank partially filled with water. A hydrostatic pressure test to 17,500 psi. is applied for 5 minutes as a precautionary measure to insure that the samples and all connections are in safe working order before using high-pressure gas.

The water solution is drained from the specimens which are then submerged in hot water and charged with nitrogen gas to 15,000 psi. and shut in. The tank is drained of hot water and refilled with cold water at room temperature, resulting in about a 100° F. change. This change in the temperature of the bath causes a corresponding change in the pressure of the gas held in the samples, resulting in a rise or fall of pressure of 2,000 psi. or more. These thermal shock cycles are repeated 100 times during which observations and a record are made of leaks.

Further tests . . . At the completion of the thermal shock tests, one-half of the group of specimens are broken out and made up 10 times in an attempt to simulate field conditions since tubing may be run and pulled several times before final setting in a well. These specimens are subjected to a second series of 100 gas-cycling tests. The half of the group of specimens not subjected to the make-and-break tests are shut in with 15,000-psi. gas pressure and observed for 90 days at atmospheric temperature.

Under this condition of test, pressure will rise and fall with changes in atmospheric temperature. Tubing connections which do not leak during these tests are considered satisfactory for 15,000-psi. service.

Casing connections and flange seals are given the same type of hydrostatic and temperature shock-cycle tests but are not subjected to make-and-break conditions. Valves are given, in addition to a proof hydrostatic test, a gas-body test and 100 gas thermal tests on each side of the gate or plug.

Equipment tested or being tested consists of 13 different types of tubing threads, 3 types of casing threads, 6 different flange seals, and 2 makes of valves. Much of the equipment, with the exception of a casing joint which was indicated to be satisfactory for 15,000-psi. service, was developed as the result of the high-pressure investigation by industry.

Selection of Equipment

The selection of wellhead equipment is in part dependent upon the casing program which is partially controlled by the method of well completion adopted. The three general completion methods being used for

"Engineers advocate that the tubing be internally coated for corrosion protection"

extremely high-pressure wells are shown in Fig. 2. The first of these methods uses a small-diameter, high-strength production string set on a packer and standard tubing set open-ended, so that full well pressure is exerted on the production string. This method permits corrosion inhibitors to give maximum benefit by injection into the casing-tubing annulus to the bottom of the well and up the inside of the tubing string.

The second method uses a string of high-strength tubing set on a packer with a small string of tubing suspended inside and open-ended; this method is essentially the same as the first method except that smaller pipe strings are used; both of these methods will permit circulating a well with heavy fluids readily should the necessity for remedial work arise.

The third method uses a string of high-strength tubing set on a packer in a conventional manner; this is the most economical and simplest type of completion. With this method, corrosion engineers advocate that the tubing be internally coated for corrosion protection because of more favorable experience with coated than with uncoated tubing in high-pressure gas-condensate wells; batch or slug injection of corrosion inhibitors is recommended to supplement the protection coating.

With any of these methods, advantage may be taken of wellhead internal seals around the casing to eliminate the need for using the highest pressure flange of the tubing head throughout the entire assembly.

Test results . . . The following descriptions of the materials, equipment, and methods are those that have been selected by Humble. Availability at the time had an effect on the selection of some of the equipment. It is pointed out that there are other methods, materials, flange seals, and tubular seals that are being used by others and are as adequate as those that will be described.

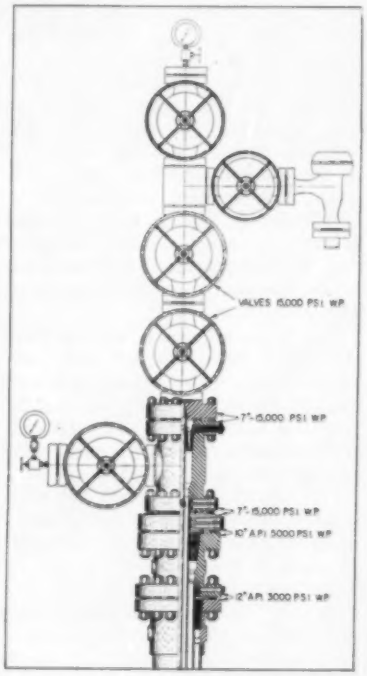
Material used in the 15,000-psi.-w.p. tubing head, valves, and flanges has a 75,000-psi. minimum yield strength and 90,000-psi. minimum ultimate strength with the same API specification of 18 per cent elongation and 30 per cent reduction of area. It is of extreme interest to note that the flange seal that was selected to be used in the assembly has a safety factor of slightly better than three to one on minimum yield strength at working pressure. This was indicated by the extensive stress analysis tests of the 2⅞ and 7⅛-in.-bore flanges.

The tubing-head adapter flange and all valves and fittings are 12 to 14 per cent chromium stainless steel, heat treated to the approximate same physical properties as the tubing head. This type of stainless steel was selected for service because it has been successful in overcoming extensive corrosion that has occurred in alloy steel valves in high-pressure gas-condensate service.

Any cast-steel valve or fitting used in the assembly is X-rayed and magnetic particle inspected prior to machining and is subjected to a 15,000-psi. dry-gas test and 22,500-psi. hydrostatic proof test.

The dry-gas-testing specification was prompted by experience with a christmas tree cast-steel fitting which leaked on a well but when tested in the shop hydrostatically before and after use did not leak. The leak was detected by means of a dry-gas shop test. Every valve is given a 15,000-psi. dry-gas test of the seats from both sides before being accepted.

Tubing . . . The 15,000-psi.-w.p. tubing is manufactured from A.P.I. Grade N-80 material having a 2⅜-in. o.d., 0.336-in. wall, and 1.703-in. i.d. It is rolled on a specialty mill to ASTM A-335 tolerances, and external defects greater than 5 per cent but less than 12½ per cent of the wall thickness are removed by grinding. It is equipped with a two-step-thread, metal-to-metal seal integral joint.



TYPICAL INSTALLATION of 15,000-psi. working-pressure wellhead assembly and christmas tree. Fig. 4.

Magnetic particle and optical inspections are made and an 8 per cent of minimum yield strength or 18,000-psi. hydrostatic test is performed to proof test the strength of each length of pipe. An internal coating is applied for corrosion protection.

API Grade N-80 material was selected in preference to higher-strength materials because of difficulty with upset cracking with some of the early attempts to manufacture tubing from high-strength material.

Casing programs used will of necessity vary with the drilling conditions, but it is desirable to have an oil string manufactured from material having physical properties greater than the highest strength API Grade P-110 or with wall thickness greater than A.P.I. weights to withstand internal pressure and external collapse.

Wellhead . . . By referring to Fig. 4, it can be seen that the wellhead assembly is conventional to the top of the section in which the oil string is suspended and packed off in an API 5,000-psi.-w.p. flange. At this juncture, a crossover packoff flange, having internal seals, is inserted below the 15,000-psi.-w.p. flanged end of the tubing-head section. Additional internal seals are placed in the bottom of the tubing head as an extra precaution to seal the 5,000-psi. flange from higher pressure above.

Because testing indicated that flange tightness is quite critical in maintaining a seal, flange bolts will be used that incorporate a positive stress indicator. An internal pin secured at one end of the bolt becomes flush with the other bolt end at the bolt tension necessary to insure proper tightness of the flange. The single high-pressure tubing string is threaded into the tubing head 15,000-psi. top adapter flange.

A wraparound-type tubing hanger and packoff are incorporated to provide for full tubing-casing annulus pressure control while setting the tubing packer and washing in the well.

This 15,000-psi.-w.p. wellhead, christmas tree, and tubing were manufactured and delivered in the early part of 1957. A stepout exploratory well drilled to the same sand as the extremely high-pressure well failed to find production from this horizon and was completed in a zone which could be handled with 10,000-psi. equipment.

How 31 Refineries Condition Cooling-Water Systems

Survey shows cost of $1-$5 per day per 1,000 g.p.m. circulated, with results worth it

By J. D. Helwig and H. F. McConomy, Atlantic Refining Co.

AN EXTENSIVE survey of the oil industry's cooling-water situation has been made by the corrosion subcommittee, committee on refinery equipment, API Division of Refining. Results of this survey, made on condition methods employed in open circulating-type systems supplied by fresh makeup water, are as follows:

- Fouling and corrosion occur in all refinery cooling-water systems when treatment is not practiced. In some systems the fouling is very heavy and corrosion rates may be as much as 0.3 to 0.4 in. per year.
- The industry recognizes the problem and is actively and effectively combating it by chemical treatments, cathodic protection, and special materials of construction. In addition many studies have been made or are in progress which will be helpful in the future.
- Each cooling-water system is a separate problem and requires a tailor-made treatment for optimum protection.
- Adequate treating methods are known and available. Costs are in the order of $1-$5 per day per 1,000 g.p.m. of water circulated and can be justified by improved heat transfer, reduced down time, and lower maintenance as well as other reduced operating costs.
- The use of polyphosphates and organic inhibitors for cooling-water treatment dominate the test programs conducted at the various refineries.

Seventeen companies have reported their experiences with conditioning methods used in 63 different cooling-water systems from 31 refineries. The refineries are located in all sections of the United States and several foreign countries. River and well waters predominate as the source of supply of makeup to the systems. The largest single system circulates approximately 60,000 g.p.m. or 2 million barrels per day.

Important factors . . . In addition to defining the present status of cooling-water treatment in the industry, this report attempts to relate various pertinent factors which should be of value in the application of these experiences to other systems and to guide refiners in developing better and less expensive treating methods. The most important of these factors are:

- Water composition vs. corrosion and fouling.
- Water composition vs. treating methods.
- Effectiveness and cost of chemical treatment.
- Equipment affected; intensity and type of fouling and corrosion.
- Cathodic protection.
- Special materials of construction.
- Chemical treatments which have been discontinued.
- Studies of treatments which have been completed or are in progress.
- Comparison of laboratory and plant testing.
- Justification for water treatment.

Water composition . . . The compositions of waters used in the reported systems vary widely because of the geographical location and the source of supply. Differences in hardness and pH of the makeup water appear to be of significant importance. In general, well waters are high in hardness

TABLE 1—COOLING-WATER COMPOSITIONS BEFORE TREATMENT

System	Total hardness, p.p.m., $CaCO_3$	Calcium, p.p.m., $CaCO_3$	Dissolved solids, p.p.m.	Total solids, p.p.m.	Methyl orange alkalinity, p.p.m., $CaCO_3$	pH
A-2						6.2
B-7	168	112				7.2
B-8	168	112				8.1
B-9	168	112				8.1
C-1*	164	450			284	8.1
C-2*	812	610			125	7.5
C-3*	390	330			320	7.3
C-4*	152	102				7.4
C-5*	544	400			56	7.6
D-1	158	48	251	489	35	7.7
D-2	158	48	251	489	35	7.7
D-3	680	136	939	943	305	7.1
D-4	680	136	939	943	305	7.1
D-5	680	136	939	943	305	7.1
D-6	128	94	170	170	90	7.1
D-7	680	136	939	943	305	7.1
E-3	104	104			0	6.5
E-4	80	80			0	6.5
E-5	128	128			0	6.0
G-1	210	140	260			8.3
I-1	238	182	340			7.5
J-1		62			26	7.0
J-2	160	125			60	7.8
K-1	600		2,400			9.0
K-2	800		2,400	2,445		
K-3	460	320	2,650		75	7.5
K-4	225	110	500	510	7	5.5
L-1	125-277				200	8.1-9.5
L-2					200	8.0-9.5
L-3					200	8.5-8.8
L-4	100					8.5-8.8
L-5	65-172				200-466	8.0-9.0

*Raw makeup water.

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TABLE 2—COOLING-WATER COMPOSITIONS AFTER TREATMENT

System	Total hardness, p.p.m., $CaCO_3$	Calcium, p.p.m., $CaCO_3$	Dissolved solids, p.p.m.	Total solids, p.p.m.	Methyl orange alkalinity, p.p.m., $CaCO_3$	pH
A-1	952	616	1,750	...	15	6.2
A-2	...	95	...	...	...	6.2
B-1	400	...	575	...	27	6.8
B-2	14	...	1,419	...	...	7.2
B-3	368	...	605	...	17	6.3
B-4	152	135	645	647	115	8.3
B-5	294	250	970	995	40	8.1
B-7	850	563	...	...	...	7.5
B-8	250	163	...	...	...	8.0
B-9	470	312	...	...	...	6.0
C-1	1,790	1,280	...	...	75	7.0
C-2	1,450	1,064	3,230	...	75	7.0
C-3	980	830	1,850	...	30	6.6
C-4	798	454	1,310	...	64	7.4
C-5	1,012	768	...	...	72	7.6
D-1	267	81	425	430	60	8.3
D-2	267	81	425	430	60	8.3
D-3	1,120	232	1,500	1,510	300	6.1
D-4	1,085	220	1,500	1,510	490	7.9
D-5	1,085	220	1,500	1,510	490	7.9
D-6	...	...	...	280	...	8.0
D-7	1,120	232	1,500	1,510	300	6.1
E-1	1,080	855	2,457	2,829	5	6.5
E-2	992	680	1,441	1,544	7	6.1
E-3	104	104	...	...	0	6.5
E-4	80	80	...	...	0	6.5
E-5	128	125	...	...	0	6.0
E-6	1,140	495	2,547	2,547	17	6.0
E-7	450	220	1,140	1,140	17	6.0
F-1	310	1	960	...	56	7.2
F-2	460	...	1,080	...	60	6.9
F-3	470	...	1,080	...	125	7.7
G-1	210	140	260	...	...	8.3
H-1	876	...	...	...	250	7.1
H-2	754	430	4,416	4,916	250	7.3
H-3	316	168	1,635	...	28	6.1
I-1	520	382	790	...	...	6.0
1-2	279	193	440	...	...	...
J-1	...	240	750	...	15	6.5
J-2	240	125	385	...	40	7.1
K-1	800	...	2,400	...	25-75	7.5
K-2	800	...	2,400	2,445	25-75	7.5
K-3	270	200	1,620	...	10	6.3
K-4	680	330	1,500	1,520	18	6.5
K-5	450	240	1,150	1,250	50	7.8-8.2
K-6	184	90	480	605	...	6.0-6.5
K-7	620	308	1,620	1,986	150	7.8-8.2
K-8	52	38	930	970	421	9.1
K-9	110	...	2,385	2,405	125	7.7
L-1	140-263	...	...	...	400-500	5.0-7.1
L-2	...	...	...	...	400-500	6.5-7.0
L-3	...	...	...	...	400-500	6.5-7.0
L-4	200	...	...	...	...	6.5-7.2
L-5	200-400	...	...	...	10-50	6.5-7.2
M-4	40	28	324	...	160	8.5
M-5	130	95	327	...	130	8.5
R-1	530	480	...	800	80	8.5
R-2	450	390	...	620	90	8.6

and pH and river waters are low in both of these characteristics. On the other hand, condensate waters are of a neutral pH and contain little hardness.

The corrosion and fouling of equipment by these waters is very much dependent on composition. Compositions of system waters before and after treatment are shown in Tables 2 and 3. Corrosion rates in untreated cooling-water systems vary from 10-375 m.p.y. This means the life of steel equipment in the system may be from 0.2 to 10 years.

In general, pH values below 7.5 accelerate corrosion. High dissolved solids, high electrical conductivity of the water, elevated temperatures, and high velocities increase corrosion rates. In systems where the circulating water is held above 8.0 pH only mild corrosion is indicated.

Fouling was heavy or severe in waters of high calcium (or total hardness) and high pH. At 8.5 pH heavy fouling occurred at 65-172 p.p.m. total hardness; no fouling occurred at 5.5 pH and 225 p.p.m.

Treating methods . . . The most prevalent treating methods used in cooling-water systems are for the purpose of pH adjustment and control of algae growth. These may be called the basic treating steps for any system. Caustic, soda ash, and sulfuric acid are widely used either alone or in combination with other chemicals to alter the hydrogen ion concentration of the water to pH values up to the range of 5.8 to 8.0. Injection of chloride in concentrations of 0.1 to 2.0 p.p.m. and other algicides are used to reduce algae growth.

In only a relatively few cases have companies been satisfied with the basic treating steps alone. Experience has shown that further control using chemicals classified as corrosion inhibitors and "sequestering" agents should be used for optimum reduction of corrosion and fouling. Chromates, bichromates, polyphosphates, and silicates are typical of these chemicals. The most popular are the polyphosphates which can be used alone or in combination with other chemicals. When used alone effective concentrations are generally maintained as follows:

Total phosphates, p.p.m.	10-50
Meta phosphate, p.p.m.	2-20
Ortho phosphate, p.p.m.	1-15

When used in combination 5-20 p.p.m. of total phosphate with 10 to 60 p.p.m. of chromate is reported to be very effective.

Chromate when used alone must be maintained in concentrations of 200-500 p.p.m. Care must be taken to maintain these concentrations because lower concentrations can promote pitting attack.

In summary:

1. Alkaline chemicals are used to raise pH of acidic water to reduce corrosion.
2. Acidic chemicals are used to lower the pH of alkaline waters to reduce fouling by carbonate deposits.
3. Chlorine and other algicides suppress algae growth.
4. Sequestering agents such as phosphates reduce the tendency of alkaline waters to deposit carbonates.
5. Chromate and phosphates alone or in combination reduce corrosion.

Effectiveness and cost . . . Comparison of the treating methods used by the various companies, their costs and effectiveness are shown in Table 3. containing selected data from the study. Evaluation of these data show the following:

Algae and slime reduction—In all but two cases excellent control of slime and algae growth was realized by use of chlorine and algicides—80 to 100 per cent is reported. Costs were as little as $0.05 per day per 1,000 g.p.m. water circulated.

pH control—The use of sulfuric acid has been very effective in reducing carbonate deposits. Control in the order of 95 per cent is reported. Its cost depends on the alkalinity of the

Table 3— Effectiveness and Cost of Chemical Treatment for Systems

System	Chemicals used for treatments	Control concentrations (p.p.m.)*	Approx. treatment costs‡ $/day	$/day/1,000 g.p.m. Circulated	$/day/1,000 g.p.m. Makeup	Effectiveness of treatment: Per cent corrosion protection	Per cent fouling reduction	Per cent slime reduction
1. Polyphosphate treatments:								
B-1	Soda ash		0.75	1.05	31.20	90	95	100
	Sulfuric acid		7.10					
	Polyphosphate	15-20 M.P.	†16.20					
	Chlorine		2.52					
B-4	Polyphosphate	2-4 M.P.	0.75	0.36	10.80	35		90
	Chlorine		1.20					
D-2	Soda ash	8.3 pH	1.35	0.045	1.60	0	75	90
	Lime	101	9.39	0.314	11.12			
	Polyphosphate	6.7 T.P.	8.34	0.278	9.86			
	Chlorine	1-2	7.10	0.237	8.42			
	Sulfate	15	4.30	0.143	5.10			
D-4	Sulfuric acid	7.5-8 pH	8.37	0.62	20.95	0	75	75
	Polyphosphate	17.4 T.P.	9.98	0.74	25.00			
	Chlorine	1-2	3.21	0.24	8.02			
E-2	Sulfuric acid		46.60	6.55	135.00			50
	Polyphosphate	10-15 M.P. 1-4 O.P.	†35.00					
	Chlorine		1.50					
	Algicide		†8.60					
E-4	Sulfuric acid	6.0-6.5 pH	4.80	1.10	49.60	90	100	100
	Polyphosphate	40 T.P.	52.60					
	Chlorine	0.5	9.00					
E-6	Sulfuric acid	5.8-6.3 pH	17.10	(1.40)	(62.00)	5 mils/yr.	90-100	95-100
	Polyphosphate	20-30 T.P.	17.50					
	Chlorine		4.50					
	Algicide							
K-8	Polyphosphate		15.00	0.75	14.65		Satisfactory	100
	Chlorine	0.8	22.50					
L-1	Sulfuric acid					50-75	50-75	Nil
	Polyphosphate	30-45						
	Na_2 Fe $(CN)_6$							
	Chlorine							
	Algicide							
2. Phosphate-chromate:								
A-1	Sulfuric acid	6.0-6.3 pH	12.00	3.05	102.00			90
	Chromate-phosphate	6.3-6.7	16.50					
	Chromate-phosphate	15 T.P.						
	Chromate-phosphate	22 Cr.						
	Chlorine		2.00					
A-2	Sulfuric acid		0.24	1.04	42.50	99	99	99
	Chromate-phosphate	50	†7.60					
	Chromate-phosphate	12 T.P.						
	Chlorine		1.50					
C-1	Sulfuric acid		4.55	1.15	80.00	90	90	90
	Chromate-phosphate	12 T.P.	†4.90					
	Chlorine		0.54					
C-4	Sulfuric acid	100 ($CaCO_3$ Al.)	2.50	0.82	22.00	85	90	90
	Chromate-phosphate	35 Cr.	†6.50					
	Chlorine		0.90					
D-1	Soda ash	8	0.781	0.039	1.535	0	75	90
	Lime	101	5.65	0.282	11.10			
	Polyphosphate	5.5	3.99	0.20	7.82			

makeup water and may be as much as $3.00 per day per 1,000 g.p.m. water circulated.

Increasing the alkalinity of cooling water by addition of caustic or soda ash is used to reduce corrosion. These chemicals are generally added to the system in combination with phosphates and chromates.

Polyphosphate treatment—Low concentration of polyphosphates (2-10 p.p.m. meta) at a total treating cost less than $1.00 per day per 1,000 g.p.m. water circulated generally have given only 35-50 per cent corrosion protection. Higher concentrations which cost $1.00 to $10.00 per day per 1,000 g.p.m. water circulated give 85-90 per cent protection.

Phosphate - chromate treatment—The combination of chromate and phosphate, at total treatment cost of less than $1.00 per day per 1,000 g.p.m. water circulated is indicated to provide protection in range of 70-85 per cent. Above $1.00 per day per 1,000 g.p.m. and at a cost of less than $5.00 per day per 1,000 g.p.m., 90-99 per cent protection is indicated.

Chromate treatment—When chromate may be used 90-95 per cent protection has been obtained at a cost of only $0.60 to $1.70 per day per 1,000 g.p.m. water circulated. Because of the higher concentrations required for this inhibitor, spray losses and leakage from the system must be kept low if these costs are to be realized. Other limitations of the use of chromate are its toxic nature and ease of reduction by H_2S and other chemicals.

Equipment affected . . . Corrosion and fouling of various intensities occurred in all steel equipment comprising the cooling-water systems. Selected data from the study are contained in Table 4. The most intense attack at rates of 94-375 m.p.y. limited the life of cooler and condenser tubes, baffles, and channels to 0.2 to 0.5 year. Under these conditions iron oxide deposits and algae growth were most evident. Pitting and tuberculation were the predominating forms of attack.

With Corrosion and Fouling Data Both Before and After Treatment

System	Chemicals used for treatments	Control concentrations (p.p.m.)*	Approx. treatment costs‡ $/day	$/day/1,000 g.p.m. Circulated	$/day/1,000 g.p.m. Makeup	Effectiveness of treatment: Per cent corrosion protection	Per cent fouling reduction	Per cent slime reduction
	Chromate	0.05	0.02	0.0007	0.039			
	Sulfate	15	2.60	0.13	51.0			
	Chlorine	1-2	2.80	0.14	1.71			
H-1	Sodium hydroxide (caustic)		10.00	1.11	53.00	90		
	Polyphosphate	6 O.P.	†7.50					
	Chromate		43.50					
K-1	Sulfuric acid	7.5 pH	4.80	1.16	53.50		95	100
	Polyphosphate	7-12 T.P.	†1.50					
	Chromate	50 Cr.	9.20					
	Chlorine		1.90					
K-9	Sulfuric acid		33.60	(1.98)	(57.40)		Satisfactory	100
	Polyphosphate	4 M.P.	3.00					
	Chromate	50 Cr.						
	Chlorine	0.8	3.00					
L-4	Sulfuric acid	6.5-7.0 pH				90	100	Excellent
	Polyphosphate	2-10 M.P.						
	Polyphosphate	6-20 T.P.						
	Chromate	30-50 Cr.						
	Chlorine	0.1-1.0						
3. Chromate treatment:								
B-2	Soda ash		0.15	1.20	198.00	90	95	100
	Chromate	500 Cr.	1.48					
	Chlorine		0.15					
B-7	Sulfuric acid			(1.70)	(125.00)	95	100	50
	Bichromate	200-250 Cr.	33.00					
	Chlorine		4.50					
H-2	Caustic		1.75	0.64	30.40	90		
	Bichromate		11.00					
P-2	Caustic		0.01	0.23		Practically		
	Chromate	1,200 Cr.	0.22			100		
4. Other treatments:								
D-3	Sulfuric acid	6.0-6.5 pH	30.40	1.65	38.00	75	90	99
	Polyphosphates	19.2	21.95	1.21	27.40			
	Copper corrosion inhibitor	3.6	12.40	0.67	15.50			
	Chlorine	1-2	1.36	0.074	1.70			
D-6	Sodium silicate	8	1.87	0.468	37.40			
F-1	Caustic	500 $CaCO_3$	2.50-21.60	0.15-0.78	8.25-43.00			100
	Chlorine		4.50-15.00					
F-2	Caustic	500 $CaCO_3$ 1,200 total solids	0.25	0.22	14.80			100
	Chlorine		1.60					
F-3	Caustic	500 $CaCO_3$ 1,200 total solids	1.35	0.29	24.80			100
	Chlorine		3.00					
M-3	Caustic	7-7.5 pH	4.00	1.52	15.20			100
M-4	Chlorine	1.0	2.10					
	Chlorine	0.75	6.00	0.11	3.00			
O-8	Chlorine		3.00	0.19	3.00			Good

*M.P.—p.p.m. metaphosphate. †Based on an assumed inhibitor brand. ‡Based on approximate average chemical costs. Parentheses only partial costs. G.p.m.—gallons per minute. P.p.m.—parts per million. O.P.—p.p.m. orthophosphate. T.P.—p.p.m. total phosphate. Cr.—p.p.m. chromate.

In systems where the composition of water caused heavy carbonate deposits, corrosion rates were much less (in the order of 10-40 m.p.y.) and appreciably greater equipment life (2-10 years) was reported. Under these conditions corrosion was generally more of a problem in piping, baffles, and channel boxes.

These parts of the cooling system in general are of greater thickness than exchanger tubes and consequently had longer lives in relation to the corrosion rates experienced. The type of attack varied widely from uniform corrosion to pitting and tuberculation.

Both of these types of corrosion and fouling were effectively controlled in most systems by chemical treatment. Some refineries, effectively controlled corrosion by use of copper alloys such as admiralty metal for tubular parts of exchangers and by use of coatings, either metallic or organic, for tube sheets, channels, and floating heads.

Cathodic protection . . . Two types of cathodic-protection systems were reported (Table 5 gives selected data from the study) to be effective for protection of cooler and condenser-tube sheets, channels, and floating heads. They are the impressed potential systems using carbon, steel, and aluminum anodes and the galvanic or sacrificial anode systems using magnesium.

In general, it appears that the degree of protection is critical to the current density provided. High densities in the order of 8-12 ma. per sq. ft. which can more easily be obtained by an impressed potential system produced 100 per cent protection. In systems employing sacrificial magnesium anodes only 85-95 per cent protection was experienced.

Lower current densities in the order of 2-5 ma. per sq. ft. appear to give erratic results and in several cases as little as 50 per cent protection was reported.

Discontinued treatments . . . Limited information is available on chemical treatments which have been discontinued. Unsatisfactory experiences were reported on the use of sodium silicate, organic phosphates, sodium nitrate, and organic chromates. Other treatments employing inorganic polyphosphates, polar organic compounds,

TABLE 4—CORROSION AND FOULING IN STEEL EQUIPMENT—BEFORE AND AFTER WATER TREATMENT

System	Equipment affected—	Water velocity, ft./sec.	Water temp. (°F.)	Location of max. corrosion	Before treatment: Type of corrosion*	Before treatment: Corrosion rate, mils/year	Before treatment: Est. life, years	After treatment: Type of corrosion*	After treatment: Corrosion rate, mils/year	After treatment: Est. life, years	Fouling: Type	Fouling: Intensity Before	Fouling: Intensity After
1. Polyphosphate treatments:													
B-1	Condensers	....	84-113	Baffles	TP	...	3	TP	...	30	None	....	....
B-4	Coolers	3.5	90-140	Exchanger and piping	P	...	10	P	...	15	(†)	Hvy.	Mod.
D-2	Coolers, condensers, exchangers	Varies	120	(‖)	...	...	...	O	(¶)	...	(‡)	....	Med.
D-4	Coolers	Varies	100-110	Gasket and surfaces	TP	50	5	TP	...	...	(§)	Hvy.	Med.
L-1	Specimens in piping	2-7	85-100	.....	...	12.4-16	...	...	5-6.7	...	....	....	....
	Exchangers	....	.....	.....	...	...	...	...	...	...	(†)	....	....
R-1	Specimens in hot-water tank	.....	194	.....	...	...	...	...	7	...	....	....	....
	Coolers	....	120	Tubes	P	10	...	...	...	...	(†)	Med.	....
R-2	Exchangers	....	.....	.....	...	...	...	...	...	...	(†)	Hvy.	Red.
2. Phosphate-chromate:													
C-1	Specimens in bypass lines	0.3-3.5	85-120	.....	...	20	...	...	0.7	...	....	....	....
	Coolers and condensers	....	90-120	Baffles	U	...	3	T		25	(†)	Hvy.	Light
D-1	Coolers, condensers	Varies	120-98	(‖)	...	...	...	O	(¶)	...	(‡)	....	Light
L-4	Specimens in piping	2-7	80-100	.....	...	11	...	...	1	...	....	....	....
	Exchangers	....	.....	.....	...	...	...	...	...	...	(†)	Hvy.	None
4. Other treatments:													
D-3	Coolers, condensers	Varies	100-200	Gasket and surfaces	TP	50	5	TP	...	...	(§)	Hvy.	Light
D-6	Wax sweaters	Varies	85	Tubes and sheet	P	.516	...	...	...	...	(§)	Light	....

*P—Pitting, T—Tuberculat, U—Uniform, O—Oxygen. †Carbonate. ‡Slime and mud. §Oxidation products and algae. ¶Varies widely. ‖Tube sheets, floating heads and channels.

organic silica, and continuous chlorination were either unsuccessful or too costly.

Wide temperature variations in one system prevented control of scale deposits and in another system hydrogen sulfide contaminants made sodium chromate treatment ineffective. This does not mean that these chemicals are unsatisfactory, but it does highlight the fact that each cooling system is a separate problem and requires a tailor-made treatment for optimum protection.

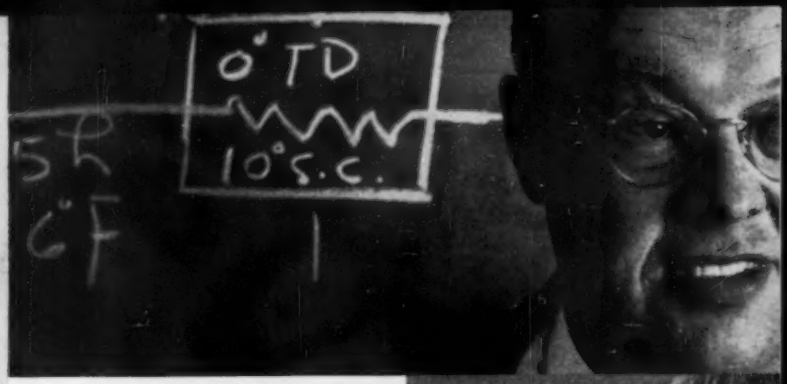
Plant testing . . . Controlled plant tests were generally rated better than laboratory tests when compared with actual plant experience. Ratings of "good" were given to about 75 per cent of the plant test data comparisons. Three refineries, however, reported "excellent" agreement between laboratory data and plant experience but most of the other refineries reported tests to be only fair or poor.

Loss of heat-transfer capacity was rated as the most important justification for cooling-water treatment, but down time and equipment maintenance were considered by many companies to be equally as important. In addition, pumping costs, cleaning costs, and water-makeup requirements were reported by several companies to also be important reasons for water treatment.

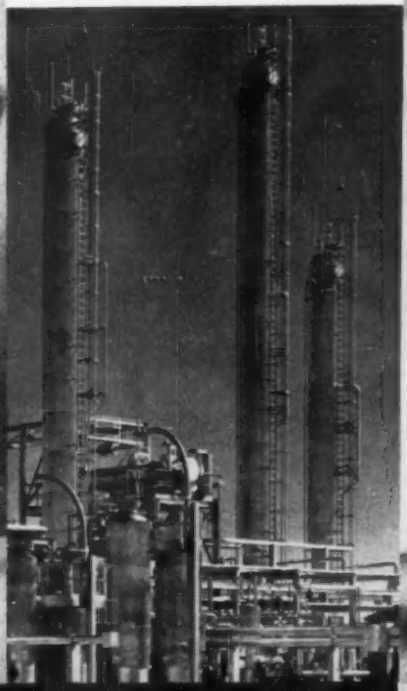
TABLE 5—SUMMARY OF CATHODIC PROTECTION EXPERIENCE

System	Equipment protected	P.p.m. dissolved solids in cooling water*	Anode material	No. of anodes	Current density (ma./sq. ft.)	Impressed potential (volts)	Per cent protection (listed in order of effectiveness)
Impressed potential:							
K-2	Cooler box	2,400	Carbon	36	8.6	6.0	100
O-5	Cooling worms	(Sea)	Carbon steel	Approx. 800	12	0.085	100
A-1	Open condenser box	1,750	Carbon steel	48	2.88	1.9	98
D-2	Open cooler box	.... ..	Aluminum	100	3.0	†2-9	50
Galvanic or sacrificial anodes							
C-1, C-2	Exchanger channel heads	(3,230 est.)	Magnesium	4 per head	....	....	95+
A-1	Open condenser box	1,750	Magnesium	12-20 per box	....	....	90-98
F-3	Exchanger channel heads	1,080	Magnesium	2 per head	....	....	92
C-4	Exchanger channel heads	(1,310 est.)	Magnesium	4	....	....	‡90+
P-1, P-3	Nonferrous tube ends and tube sheets	38,800 total solids (sea)	Mild steel	At least 50 per cent of exposed tube sheet	....	....	90
J-2	Exchanger channel heads	(425 est.)	Magnesium	2-7″, 1-15″	3-5	....	50
M-2	Exchanger channel heads	21,000 (sea)	Magnesium	2-6	....	....	20-30

*Fresh water in all cases where the type is not indicated. †At 30-40 amp. ‡Estimated.



WHEN you consider expansion...
...the most important
investment you can make is in
the creative ability of men.



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A DRY OR MUDDY PIN is usually one of the first indications of improper tonging. Fig. 1.

BROKEN PIN THREADS are also the result of wobble. Fig. 3.

WORN OR SHARP THREADS are the result of wobble. Fig. 2.

Improper tonging caused the damage shown here . . . To prevent it make sure of your . . .

A. P. Farr
Assistant Chief Product Engineer,
Hughes Tool Co.

IN ORDER to determine torque requirements it is necessary to know the type of rotary shouldered connection, its outside diameter and bore. Tool joints of a given type have accepted standard o.d.'s and bores. There are no such recognized standards for drill collars.

Thus, when considering torque requirements for drill collars, it is first necessary to select a rotary shouldered connection which will provide proper strength balance between pin and box when used on a collar having the desired o.d. and bore.

History of trouble . . . In the development of the rotary-drilling process there has been a continuous history of trouble with rotary shouldered connections. Connections have been and continue to be reworked or scrapped and discarded because of physical damage in the form of crowned shoulders, lapped threads, broken threads, galled threads, galled shoulders, and broken pins. In many cases these troubles can be traced to improper makeup of the pin and box connections.

Figs. 1-6 illustrate some of the types of damage which result from improper tonging.

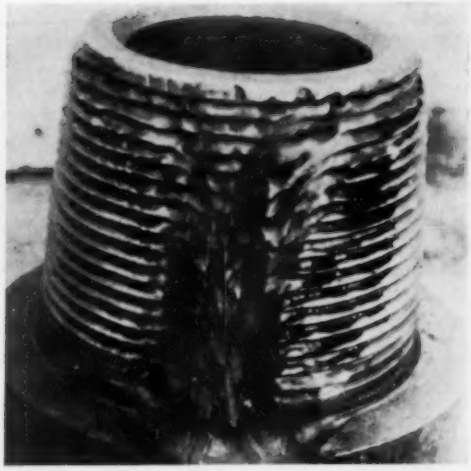
The best evidence that such troubles stem from improper makeup is that experience has shown they can be overcome by putting the connections into good condition and adopting proper tonging practices.

For many years the rule of thumb for tool-joint makeup was one wrap of the tong line on the cathead for each nominal inch of connection size. Thus, a 3½-in. connection called for three wraps on the cathead, the 4½-in. size required four wraps on the cathead, and so on. This rule, while surprisingly effective, did not take into account such variables as the size of the roughneck, his inclination to work, or the variation in the coefficient of friction between the rope and the cathead.

Field torques . . . The first attempts to arrive at proper makeup figures for rotary shouldered connections were begun by determining what actual torques were employed in field operations. Actual measurements of torque applied on the rig were made in West Texas, the Texas Gulf Coast, and in the Oklahoma-Kansas area. These measurements showed that 4½-in. full-hole joints were being made up at torques from 5,000 to 23,000 lb.-ft. Such a wide variation in torque and also a wide range of troubles made a specification based on actual practice seem very inadequate.

In an effort to provide more accurate information on torque requirements for tool joints, laboratory tests were made to determine coefficients of friction of various lubricants. The minimum coefficient of friction, obtained with stearic acid, was 0.042 and the maximum, obtained with dry, as machined, surfaces was 0.133. The

DAMAGED THREADS result when threads broken due to wobble are backed out. This is not a true gall. Fig. 4.



WASHOUT OF THREADS resulting from wobble which occurred because of improper tonging. Fig. 5.

Torque Requirements For Rotary Shouldered Connections

BROKEN PIN which resulted from severe wobble of pin in box. Fig. 6.

test results indicated 0.08 as a practical choice for normally used lubricants on joints in good condition.

The following modified screw-jack formula,[1] when used with a coefficient of friction of 0.08 and a stress equal to the yield strength of the material, gives the torque required to produce yielding due to axial tension in the pin or axial compression in the box. This formula was used to calculate the torque for various commonly used connections.

$$T = SA^* [(p/2\pi) + (R_t f/\cos\theta) + R_s f)]$$

where:

- T = torque, lb.-in.
- S = stress in section at which A* is measured
- A* = tension area of pin at thread root ¾ in. from shoulder or compression area of box at an arbitrary point ⅜ in. from shoulder — whichever area is less, sq. in. (See Fig. 7)
- p = thread pitch, in.
- R_t = average mean thread radius, in.
- R_s = mean shoulder radius, in.
- θ = ½ included angle of thread, degrees
- f = coefficient of friction
- B_s = width of unbeveled box shoulder, in.
- L_t = length of engaged thread, in.

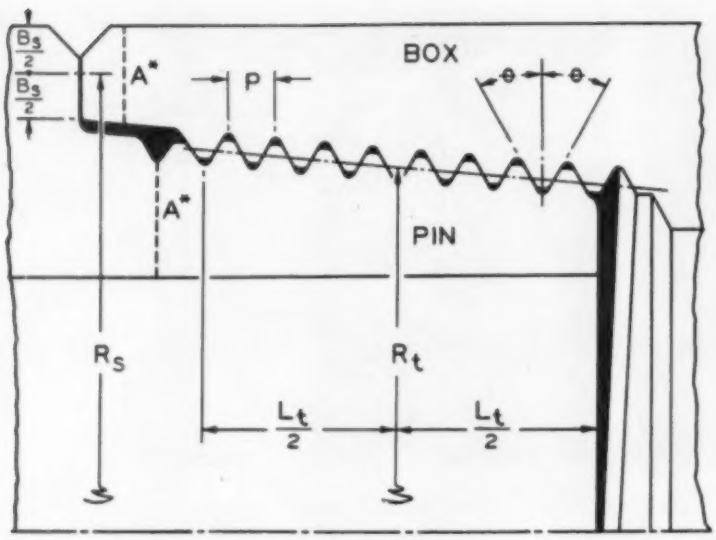
To arrive at the minimum limit of torque it was first necessary to make sufficient laboratory fatigue tests to determine the endurance limit for a rotary shouldered connection having no shoulder support or in effect the endurance limit of a pin having no initial tensile stress due to buck up.

This was found to be 13,000 psi. at a million revolutions for normally used tool-joint material with normal hardness (285-321 Brinell). (The critical section of a pin is considered as the section through the thread root ¾ in. from the shoulder, since this is the section where pin fatigue failures are most common.)

The tensile stress induced by buck-up decreases the endurance limit of the pin. However, the benefit of shoulder support in a bucked-up connection considerably outweighs the detriment of the tensile stress induced in the pin. To realize this gain a connection must be bucked-up so that the shoulders never separate in service.

Thus, it seems reasonable that the minimum torque required is that which will produce sufficient pin tension and resulting box shoulder compression to prevent the shoulders from separating when the connection is loaded in bending to the point that the endurance limit is reached at the critical section in the pin.

Table 1 gives the recommended torque range for the most popular sizes and types of tool-joint connections. Table 2 shows the recommended torque ranges for the most popular sizes and types of drill collars. It is



PIN-AND-BOG connection diagram shows various dimensions and tension area of pin, A. Fig. 7.

necessary that the **smaller** of the two areas be used in selecting the recommended torque.

Drill collars . . . The selection of drill-collar connections requires special consideration since there are no accepted standard o.d.'s and bores for given connections.

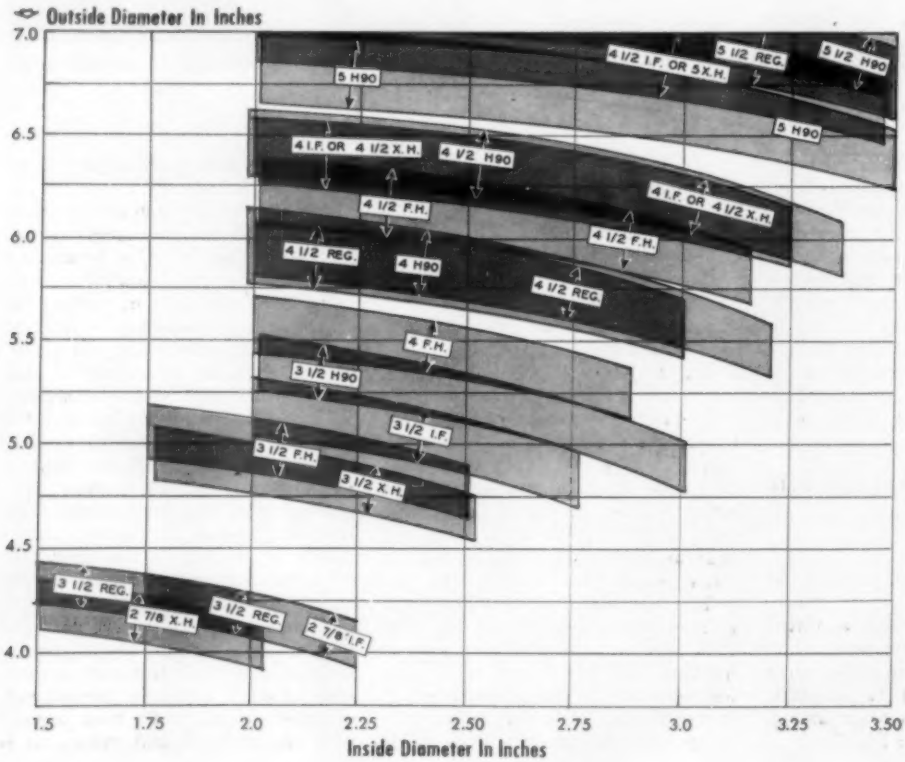
The selection of a balanced connection for drill collars is a recurring problem in drilling operations. It occurs when specifying connections for new collars, when worn collars are being reworked in field shops, and is particularly troublesome when specifying connections for collars of different diameters to be used in the same string. The charts are intended to serve as a guide in these selections.

After examining a number of methods of comparing connections on a wide range of drill collar sizes, these charts have been prepared as a good approach to the problem. They were prepared using H-90, regular API, API full hole, internal flush, and extra hole connections ranging in size from 2⅞ to 8⅝ in.

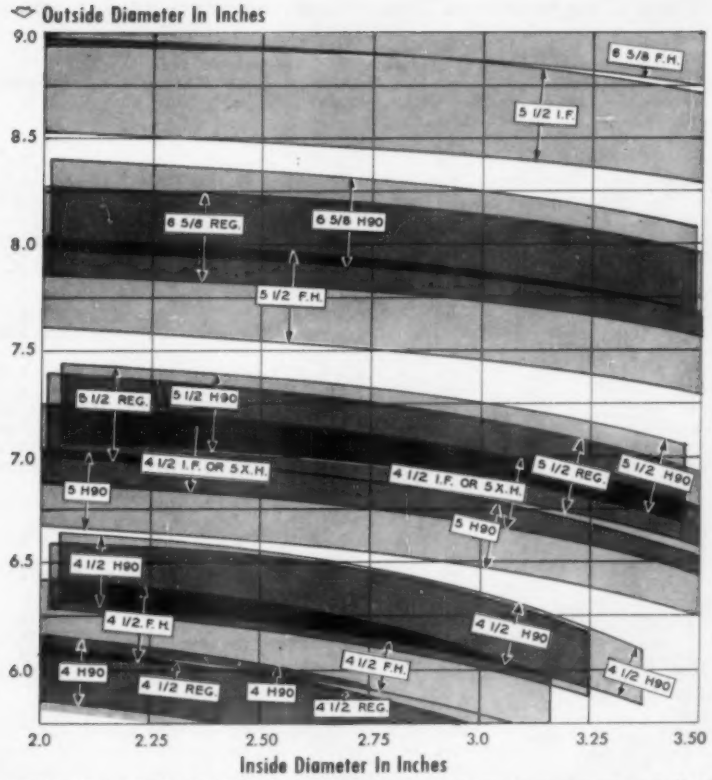
Each size and type connection is represented by a box on the chart. Fig. 8 is used for drill collars from 3¾ to 7 in. o.d., Fig. 9 for 5¾ to 9 in. o.d., and Fig. 10 for 8¼ to 11½ in. o.d. The inside diameters from 1½ to 4 in. cover the range of normal practice.

The charts use a comparison of the section modulus (and therefore strength in bending) of two critical sections of the connection; the pin section at the root of the last engaged thread ¾ in. from the shoulder, and the box section at the root of the first engaged thread ⅜ in. from the end of the pin. Examination of connections which are generally considered to be well balanced shows the ratio of box section modulus to pin section modulus at these critical points to be about 2.5.

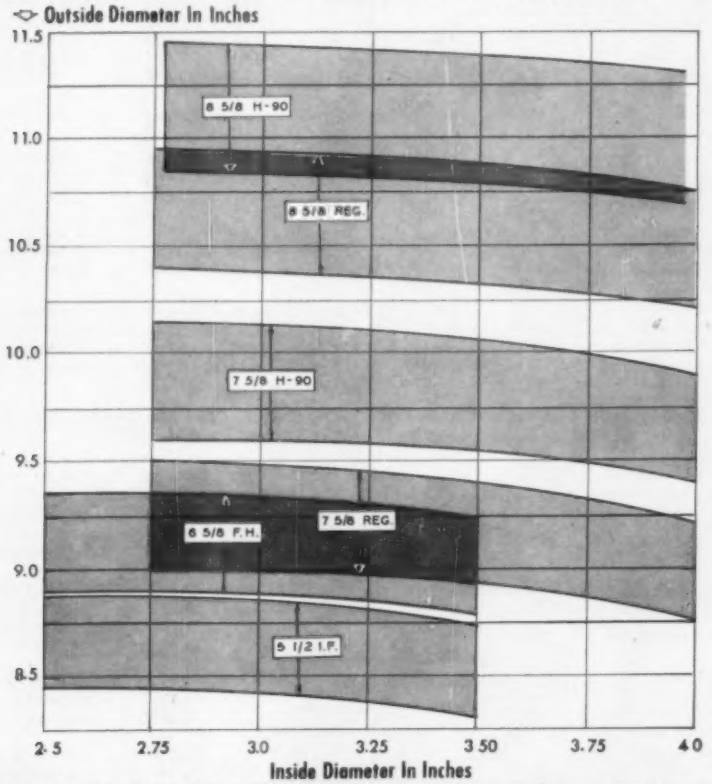
The charts were prepared with a ratio of 2.75 as the upper limit of each zone. This would imply a balanced connection at the center of the zone for each connection, with the box stronger relative to the pin above the center, and the pin stronger relative to the box below the center.



DRILL - COLLAR - CONNECTION selection chart. Selection from the upper half of zone for each connection favors box strength; selection from lower half favors pin strength. Fig. 8.



DRILL-COLLAR-CONNECTION selection chart. Selection from the upper half of zone for each connection favors box strength; lower half, pin strength. Fig. 9.



DRILL-COLLAR-CONNECTION selection chart. Selection from the upper half of zone for each connection favors box strength; lower half, pin strength. Fig. 10.

The normal procedure for selections of a connection is to enter the chart with the outside and inside diameters of the drill collar in question, and to use the connection indicated by the zone in which the point occurs. The selection will be modified by local operating practice, predominance of failures in recent experience, and other pertinent factors.

Certain cautions should be observed in the case of these charts. Adequate shoulder width and section at the end of the pin must be maintained. The calculations are based on standard dimensions for all connections and no allowance is made for variations in pin length or other modifications.

As an example in the use of the charts, assume that a string of collars, originally 6¾ in. o.d. by 2¼ in. i.d. using 5-in., H-90 connections, has been worn down to 6⅜ in. o.d. and new connections are to be turned.

From Fig. 8, the 4½-in. H-90 would be the best balanced connection. Use of 4½-in. full hole would favor the box and would provide a balanced connection as o.d. wear continued. If 5-in. H-90 is used again, the connection will be unbalanced in favor of the pin and this condition will be aggravated by more o.d. wear.

In conclusion, in 1956 there were 58,206[2] wells drilled for a total footage of 235,221,293 ft. of hole. This probably required between 30 and 40 million buck-up operations. Improper tonging on any of these connections might have resulted in trouble ranging from a slightly damaged connection to loss of a drilling string or even loss of a hole.

The possibility of preventing such trouble justifies the application of proper makeup torque.

Acknowledgment

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(Tables 1 and 2 appear on the next three pages).

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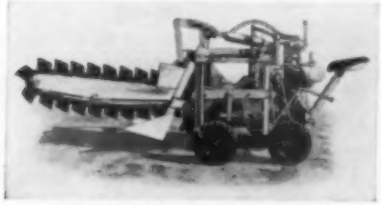

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TABLE 1—RECOMMENDED TORQUE FOR TOOL-JOINT CONNECTIONS

Size and type connection—	O.d. (in.)	I.d. (in.)	Sectional area of pin (sq. in.)	Sectional area of box (sq. in.)	Torque range (lb. ft.)
2⅜-in.:					
Reg.	3⅛	1	3.02	2.39	3,000- 3,500
I.F.	3⅜	1 3/4	2.61	2.45	3,000- 3,500
Acme	3⅛	1	2.71	2.62	3,500- 4,000
E.F.	2½	1	1.75	1.57	1,000- 1,500
2⅞-in.:					
Reg.	3¾	1 1/4	3.99	4.12	6,000- 7,000
I.F.	4⅛	2 1/8	3.73	4.33	5,000- 7,000
Acme	3¾	1 1/4	3.67	4.25	5,000- 7,000
S.H.	3⅜	1 3/4	2.61	2.45	3,000- 3,500
X.H.	4¼	1 7/8	4.21	5.65	6,000- 8,000
E.F.	3	1 1/16	2.85	2.28	2,500- 3,000
3½-in.:					
Reg.	4¼	1 1/2	5.67	4.74	7,000- 9,500
F.H.	4⅝	2 7/16	5.35	4.53	7,000- 9,000
I.F.	4¾	2 11/16	4.89	5.06	7,500-10,000
Acme	4¼	1 7/8	4.52	4.71	7,000- 9,000
A.S.L.	4⅝	2 5/16	5.48	4.91	7,500-10,000
A.S.L.	4⅝	2 7/16	5.01	4.91	7,500-10,000
D.S.L.	3⅞	1 13/16	4.39	3.26	4,500- 5,500
S.H.	4	2 1/8	3.73	3.54	5,000- 6,500
X.H.	4¾	2 7/16	4.76	6.31	9,000-12,000
E.F.	3⅝	1 1/2	3.76	3.40	4,500- 6,000
H-90	5¼	2 3/4	5.40	8.28	8,000-11,000
H-90	5½	2 3/4	5.40	10.39	8,000-11,000
4-in.:					
F.H.	4¼	2 13/16	5.93	7.25	9,000-12,000
I.F.	5¾	3 1/4	7.51	7.54	12,500-16,500
S.H.	4½	2 9/16	4.27	4.49	7,000- 9,000
H-90	5	2 13/16	7.48	7.85	12,500-16,500
4½-in.:					
Reg.	5½	2 1/4	9.89	7.18	12,000-16,000
F.H.	5¾	3	7.92	8.01	13,500-17,500
F.H.	5¾	3 5/32	7.16	8.01	12,000-16,000
I.F.	6⅛	3 3/4	7.83	7.82	13,000-17,000
Acme	5½	2 1/2	8.45	7.38	12,000-16,000
A.S.L.	5¾	3	7.93	7.86	13,500-17,500
A.S.L.	5¾	3 5/32	7.18	7.86	11,500-15,500
X.H.	6	3 1/4	7.51	9.85	12,500-16,500
E.F.	4⅛	2 3/16	5.67	5.84	9,000-12,000
H-90	6	3 1/4	7.67	9.97	12,500-16,500
H-90	6¼	3 1/4	7.67	12.37	12,500-16,500
5-in.:					
X.H.	6¼	3 3/4	7.83	9.03	13,000-17,000
5½-in.:					
Reg.	6¾	2 3/4	13.99	12.16	23,000-27,000
F.H.	7	3 13/16	11.52	11.66	21,500-25,500
F.H.	7	4	10.37	11.66	19,000-23,000
I.F.	7⅜	4 13/16	10.55	10.64	20,000-24,000
Acme	6¾	3	13.84	11.17	20,500-24,500
A.S.L.	7	3 13/16	12.19	11.05	20,000-24,000
A.S.L.	7	4	11.04	11.05	20,000-24,000
6⅝-in.:					
Reg.	7¾	3 1/2	14.76	18.90	26,500-30,500
F.H.	8	5	11.87	14.15	22,500-26,500
I.F.	8½	5 29/32	12.32	13.12	23,000-27,000
Acme	7¾	3 1/2	18.12	15.21	29,500-33,500

TABLE 2—RECOMMENDED TORQUE FOR DRILL COLLAR CONNECTIONS
(Use the Smaller Value for Pin and Box Combination)

Size and type connection—	End	I.d.	O.d.	Sectional area (sq. in.)	Torque range (lb. ft.)
3½ I.F.	PIN	1¾	. . .	8.16	14,000-18,000
		2	. . .	7.43	12,000-16,000
		2¼	. . .	6.59	10,500-14,500
3½ I.F.	BOX	. . .	5	7.07	11,500-15,500
		. . .	5¼	9.09	16,000-20,000
		. . .	5½	11.19	21,000-25,000
		. . .	5¾	13.40	24,500-28,500
3½ H-90	PIN	2	. . .	8.20	14,000-18,000
		2¼	. . .	7.37	12,000-16,000
		2½	. . .	6.43	10,000-14,000
3½ H-90	BOX	. . .	5	6.27	10,000-14,000
		. . .	5¼	8.28	14,500-18,500
		. . .	5½	10.39	19,000-23,000
		. . .	5¾	12.60	23,500-27,500

TABLE 2—RECOMMENDED TORQUE FOR DRILL COLLAR CONNECTIONS
(Continued)

(Use the Smaller Value for Pin and Box Combination)

Size and type connection—	End	I.d.	O.d.	Sectional area (sq. in.)	Torque range (lb. ft.)
4 F.H.	PIN	2	...	9.00	16,000-20,000
		2¼		8.17	14,000-18,000
		2½		7.23	12,000-16,000
		2¾		6.20	10,000-14,000
4 F.H.	BOX	...	5¼	7.25	12,000-16,000
		...	5½	9.36	16,500-20,500
		...	5¾	11.57	22,000-26,000
		...	6	13.88	25,500-29,500
		...	6¼	16.28	28,000-32,000
4 H-90	PIN	2¼	...	9.17	16,000-20,000
		2½	...	8.78	15,000-19,000
		2¾	...	7.75	13,000-17,000
4 H-90	BOX	...	5¾	10.06	18,000-22,000
		...	6	12.37	23,000-27,000
		...	6¼	14.78	26,500-30,500
		...	6½	17.28	29,500-33,500
4½ F.H.	PIN	2		12.08	23,000-27,000
		2¼		11.24	21,000-25,000
		2½		10.31	19,000-23,000
		2¾		9.28	16,500-20,500
4½ F.H.	BOX	...	5¾	8.01	14,000-18,000
		...	6	10.32	19,000-23,000
		...	6¼	12.73	24,000-28,000
		...	6½	15.30	27,000-31,000
4½ Reg.	PIN	2¼	...	9.89	18,000-22,000
		2½	...	8.95	16,000-20,000
		2¾	...	7.92	13,500-17,500
4½ Reg.	BOX	...	5½	7.18	12,000-16,000
		...	5¾	9.39	17,000-21,000
		...	6	11.70	22,000-26,000
		...	6¼	14.11	25,500-29,500
4½ X.H.	PIN	2¼	...	11.83	22,000-26,000
		2½	...	10.90	20,000-24,000
		2¾	...	9.87	18,000-22,000
4½ X.H.	BOX	...	5¾	7.54	12,500-16,500
		...	6	9.85	18,000-22,000
		...	6¼	12.25	23,000-27,000
		...	6½	14.76	26,500-30,500
4½ H-90	PIN	2¼	...	11.99	22,500-26,500
		2½	...	11.06	20,500-24,500
		2¾	...	10.03	18,000-22,000
4½ H-90	BOX	...	6	9.97	18,000-22,000
		...	6¼	12.37	23,000-27,000
		...	6½	14.88	26,500-30,500
		...	6¾	17.48	29,500-33,500
4½ I.F. and 5 X.H.	PIN	2¼	...	14.889	26,500-30,500
		2½	...	13.957	25,500-29,500
		2¾	...	12.927	24,000-28,000
4½ I.F. and 5 X.H.	BOX	...	6½	11.529	21,500-25,500
		...	6¾	14.129	25,500-29,500
		...	7	16.828	28,500-32,500
		...	7¼	19.624	31,500-35,500
5 H-90	PIN	2¼	...	13.96	25,300-29,500
		2½	...	13.03	24,000-28,000
		2¾	...	12.00	22,500-26,500
5 H-90	BOX	...	6½	12.68	23,500-27,500
		...	6¾	15.28	27,000-31,000
		...	7	17.99	30,000-34,000
		...	7¼	20.78	33,000-37,000
5½ Reg.	PIN	2¼	...	15.95	28,000-32,000
		2½	...	15.02	26,500-30,500
		2¾	...	13.99	25,500-29,500

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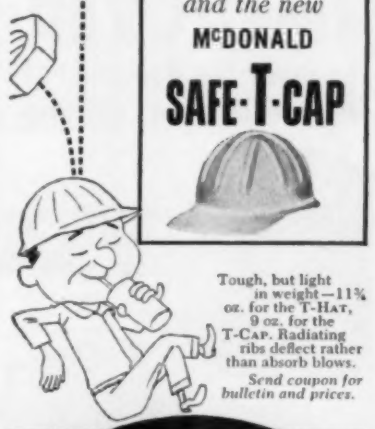

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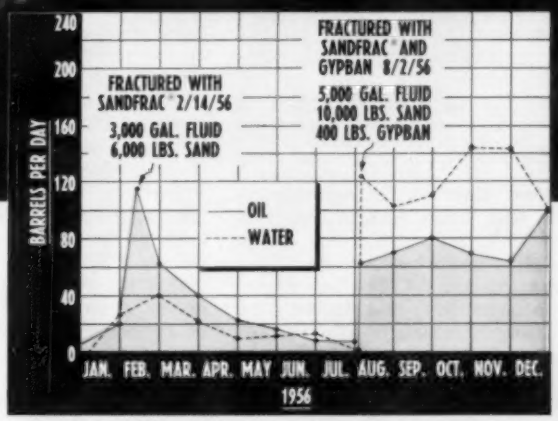
TABLE 2—RECOMMENDED TORQUE FOR DRILL COLLAR CONNECTIONS (Continued)

(Use the Smaller Value for Pin and Box Combination)

Size and type connection—	End	I.d.	O.d.	Sectional area (sq. in.)	Torque range (lb. ft.)
5½ Reg.	BOX	...	7	14.86	26,500-30,500
		...	7¼	17.66	29,500-33,500
		...	7½	20.56	33,000-37,000
		...	7¾	23.55	36,000-40,000
5½ F.H.	PIN	2¼	...	18.96	31,000-35,000
		2½	...	18.03	30,000-34,000
		2¾	...	17.00	29,000-33,000
		3	...	15.87	28,000-32,000
		3¼	...	14.64	26,500-30,500
5½ F.H.	BOX	...	7¼	14.46	26,000-30,000
		...	7½	18.36	30,500-34,500
		...	7¾	20.35	33,000-37,000
		...	8	23.44	36,000-40,000
5½ H-90	PIN	2¼	...	16.05	28,000-32,000
		2½	...	15.12	26,500-30,500
		2¾	...	14.09	25,500-29,500
		3	...	12.96	24,000-28,000
5½ H-90	BOX	...	7	15.79	28,000-32,000
		...	7¼	18.57	30,500-34,500
		...	7½	21.49	33,500-37,500
		...	7¾	24.48	37,000-41,000
6⅝ Reg.	PIN	2¼	...	20.40	33,000-37,000
		2½	...	19.47	31,000-35,000
		2¾	...	18.44	30,500-34,500
		3	...	17.31	29,000-33,000
		3¼	...	16.08	28,000-32,000
6⅝ Reg.	BOX	...	7¾	18.90	31,000-35,000
		...	8	21.99	34,000-38,000
		...	8¼	25.18	37,500-41,500
6⅝ H-90	PIN	2¼	...	21.32	33,500-37,500
		2½	...	20.39	33,000-37,000
		2¾	...	19.36	31,000-35,000
		3	...	18.23	30,000-34,000
		3¼	...	17.00	29,000-33,000
6⅝ H-90	BOX	...	7¾	18.90	31,000-35,000
		...	8	22.00	34,000-38,000
		...	8¼	25.18	37,500-41,500
7⅝ Reg.	PIN	2¼	...	27.41	40,000-44,000
		3	...	26.28	39,000-43,000
		3¼	...	25.06	37,500-41,500
		3½	...	23.73	36,000-40,000
		3¾	...	22.31	34,500-38,500
7⅝ Reg.	BOX	...	8¾	21.98	34,000-38,000
		...	9	25.47	38,000-42,000
		...	9¼	29.05	42,000-46,000
		...	9½	32.73	45,500-49,500
7⅝ H-90	PIN	3	...	31.44	44,000-48,000
		3¼	...	30.21	43,000-47,000
		3½	...	28.90	42,000-46,000
		3¾	...	27.47	40,000-44,000
7⅝ H-90	BOX	...	9½	21.77	34,000-38,000
		...	9¾	25.54	38,000-42,000
		...	10	29.42	42,000-46,000
8⅝ Reg.	PIN	3	...	36.73	50,000-54,000
		3¼	...	35.51	48,000-52,500
		3½	...	34.18	47,500-51,500
		3¾	...	32.76	45,500-49,500
8⅝ Reg.	BOX	...	10¼	32.62	45,500-49,500
		...	10½	36.70	50,000-54,000
		...	10¾	40.87	54,500-58,500
8⅝ H-90	PIN	2¾	...	42.80	57,000-61,000
		3	...	41.67	55,500-59,500
		3¼	...	40.44	54,000-58,000
		3½	...	39.12	52,500-56,500
		3¾	...	37.70	51,000-55,000
8⅝ H-90	BOX	...	10¼	23.08	36,000-40,000
		...	11	27.35	40,000-44,000
		...	11¼	31.71	44,000-48,000

Plugging action of gyp, shown here in this deposit taken from oil well tubing, can now be prevented with Gypban.



Here are oil and water production curves on a well fractured with and without Gypban. Following treatment with Gypban, increased production was sustained for over five months — unrestricted by gyp deposits!

NEW!

GYPBAN PREVENTS GYP DEPOSITS

In many wells abnormal production declines result from gyp deposits. Calcium carbonate and sulfate clog formations, collect on rods, pumps and tubing to restrict production. These deposits make frequent workovers necessary—increasing your production costs.

To solve this problem, Dowell now offers Gypban*—a new complex phosphate that acts as a stabilizing agent to retard gyp deposit. Injected into the producing formation, it dissolves slowly in the produced water to give *long-term protection.*

Gypban is granular in form. It can be squeezed directly into the formation or mixed with the sand during a fracturing job. Oil or water-base fluids may be used as the carrying medium.

With Gypban you get sustained protection instead of just temporary relief. Some wells that had previously required monthly workovers to remove gyp now give good production for six months or more after a treatment with Gypban.

The use of Gypban is recommended in any well where gyp deposits are the suspected cause of rapid or unusual decline rates. The formation may be plugged with gyp even though the tubing is free from scale.

Gypban is now available from any of the 165 Dowell service points in the U. S. and Canada. In Venezuela contact United Oilwell Service. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

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Part 8 on storage stability

The REFINER'S NOTEBOOK

How Insoluble Gum Values Vary

By F. G. Schwartz and C. C. Ward

HYDROCARBONS in the diesel-fuel boiling range were used in the blending tests. These hydrocarbons include a paraffin, olefin, tetralin, decalin, naphthalene, and an alkylated benzene.

The catalytically cracked fuels used in the blends included western Mid-Continent, Rocky Mountain, Venezuelan, and Canadian blends. Each was incompatible with straightrun fuels. The blends were stored in vented bottles for 39 weeks at 110° F. It was assumed that the pure hydrocarbons were stable and formed no gum, so the blend should form about half as much gum as the unblended fuel. On this basis the insoluble gum values of the blends ranged from about half to as high as 2½ times the anticipated values.

Highest values . . . The highest insoluble gum values were in blends of fuel with the paraffin, the olefin, and the decalin, but in no blend was there evidence of the high degree of incompatibility that resulted from blending the catalytically cracked fuels with straightrun fuels.

Data obtained in the 800 series indicate no significant differences between blends of catalytically cracked fuels with selected paraffins, olefins, decalins, tetralins, aromatics, or naphthalenes. This may be evidence that straightrun fuels contain some component or components, other than hydrocarbons that cause incompatibility of these fuels and catalytically cracked fuels.

Comparison of Drum and Bottle Storage

Twenty-four of the fuels, consisting of 11 straightrun, 5 thermally cracked, and 8 catalytically cracked, were used in this program. These fuels were stored in three different ways as described.

Authors are with Petroleum Experimental Station, Bureau of Mines, USDI, Bartlesville, Okla.

Drum storage at ambient temperature . . . Approximately 50 gal. of each oil was stored using vented 55-gal. drums. The drums were protected from the direct sunlight and rain or snow, but otherwise were subject to atmospheric conditions. Before sampling, the contents of each drum were mixed by rolling.

Bottle storage at ambient temperature . . . The fuels were placed in vented pint bottles with 20 per cent outage, which were stored in a light, tight box adjacent to the drums.

Bottle storage at 110° F. . . . The fuels were stored in vented pint bottles with 20 per cent outage in a controlled temperature room at 110° F. The room was cooled 2 hours each day to facilitate breathing in the sample bottles.

The same interim tests were used for these fuels as previously described—insoluble gum, soluble gum, and light transmission.

Insoluble gum was not determined on the drum samples until the end of the storage period because of the difficulty in obtaining representative samples.

At the end of the 12-month storage period, the fuels in the drums were filtered to obtain the "precipitated insoluble residue." A representative sample of this residue was extracted in a filter with methyl alcohol-acetone gum solvent to remove the rust, and the solvent was evaporated before weighing to obtain the percentage of gum in the residue.

The alcohol-acetone gum solvent to remove the "adherent insoluble gum" that was deposited on the inside surfaces of the drum. The solvent was evaporated to recover the "adherent insoluble gum" and the weight of this gum was added to the weight of the "precipitated insoluble gum" to obtain a value for total insoluble gum comparable to that obtained in bottle storage.

Bottle and drum storage at ambient temperature . . . A comparison is possible between insoluble gum formed in bottle and drum storage, both at ambient temperature. The gum values for the fuels aged in bottles were approximately 0.8 the insoluble gum values for those same fuels aged in drums.

A similar comparison for soluble gum formed at ambient temperature in bottle storage and drum storage indicates that the gum formed in the fuels aged in bottles was approximately 0.9 of that formed in the samples aged in drums.

A better comparison is possible for light transmission than for the gum values as more intermediate and high values were obtained. A reasonably good correlation was noted between bottle and drum storage at ambient temperature, the samples in bottle storage having approximately 1.1 times the light transmission of those in drum storage.

Bottle storage at 110° F. and ambient temperature . . . A comparison of insoluble gum formed in fuels aged at 110° F. for 13 weeks with insoluble gum in fuels aged at ambient temperature for 12 months, all fuels stored in vented pint bottles, shows that for catalytically cracked fuel, storage at ambient temperature for 12 months is approximately 1.3 times as severe as storage at 110° F. for 13 weeks.

Comparing soluble gum values for fuels aged at 110° F. for 13 weeks plotted with the amounts of gum formed in fuels aged at ambient temperature for 12 months, all fuels in vented pint bottles, shows that storage at ambient temperature is only 0.7 as severe as storage at 110° F. for 13 weeks.

The percentage of light transmission through fuels stored in bottles at 110° F. for 13 weeks was roughly equivalent to that through fuels from bottles held at ambient temperature for 12 months.

Pumps Thrive on Regular Oiling

. . . make sure yours get it

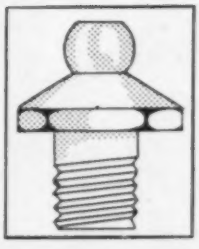
ON HORIZONTAL pumps with large oil reservoirs a gage glass (see Fig. 3, Part 1) is sometimes used to show the level of the oil. When a gage glass is used, however, the pump must be checked more often to make sure that the proper level is being maintained.

Some horizontal centrifugal pumps are grease-lubricated. They may have either Alemite fittings (see Fig. 4) or turndown cups (see Fig. 5) installed on the bearing housing. Turndown cups are preferred because no grease gun is required and there is less chance of forcing too much grease in the housing. The bearing housing should never be over half full of grease when the pump is not running.

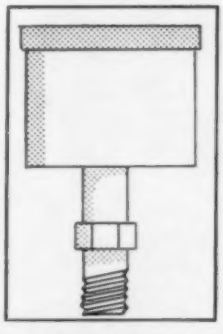
The majority of vertical process pumps do not require lubrication. The bearings on these pumps run in the fluid which is being pumped. Some designs do require lubrication, however. In this case, either a sight-feed oiler (see Fig. 6) or a special type of forced-feed lubricator is used to supply the oil.

Reciprocating pumps . . . The liquid end of reciprocating pumps does not require lubrication. The liquid being pumped lubricates all moving parts. The external parts, such as the rocker-arm linkages, are usually lubricated by hand. Only a small amount of oil should be put on these external parts, since any excess runs off and collects dirt and makes for poor housekeeping conditions.

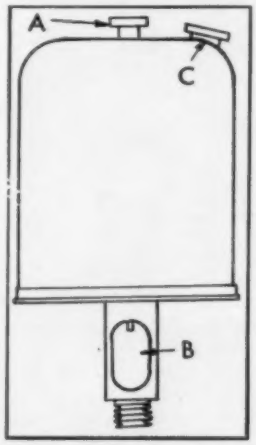
The steam end of reciprocating pumps does require lubrication. Oil is injected into the inlet steam line and is carried into the cylinder by the steam. A forced-feed lubricator (see Fig. 7) is the best device to use for this purpose. The biggest advantage of this device is that it operates only when the pump is running. Another type of oiler, called a hydrostatic lubricator (see Fig. 8) is frequently used. However, it is not as reliable as the forced-feed lubricator and must be turned on and off by hand.



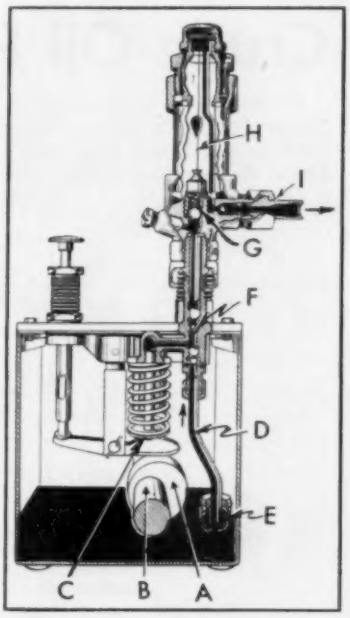
ALEMITE fittings are used on some types of grease-lubricated horizontal centrifugal pumps. Fig. 4.



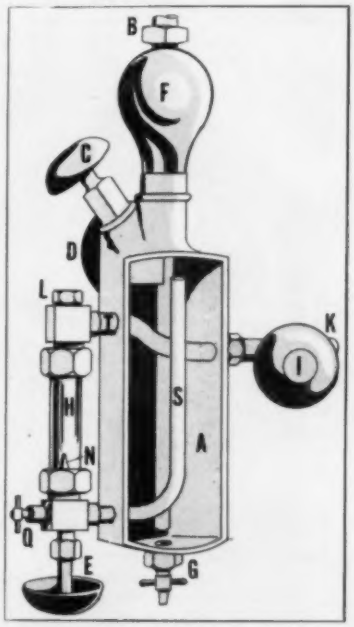
TURNDOWN cups may be installed on bearing-housing of grease-lubricated horizontal centrifugal pumps. Fig. 5.



SIGHT-FEED oiler is used in some vertical process-pump designs to provide bearing lubrication. Fig. 6.



FORCED-FEED lubrication is the best device for lubricating the steam end of reciprocating pumps. Fig. 7.



HYDROSTATIC LUBRICATOR is another oiler frequently used for the steam end of the reciprocating pump. It must be turned on and off by hand. Fig. 8.

Questions on
TECHNOLOGY

Character or Base of Crude-Oil Products

By W. L. Nelson
Technical Editor

We thank you for your answer of March 18, 1957, relating viscosity-gravity-constant and characterization factor. Do you have similar relationships for other factors or constants?—F.W.P.

Note the tabulation on this page.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
							Aniline Point* (°F.)							Visc. Index*			
	API of fractions			Correlation Index					Diesel fuels		Kerosine		Kauri				
Characterization Factor†—	Gaso.	Kero.	G.O.	Key 1	Key 2	Visc. gr. constant*	Solvents	D fuels	Diesel Index*	Cet. No.*	Smoke Point	Ring No.*	Butanol*	Raw lubes	Pour+ 20° F.	Ther. crack. O.N.*	C/H ratio*
B.P., °F.¶	235	504	755	493	715	800	300	550	550	...	437	437	300	...	...	...	500
PARAFFIN BASE																	
12.9	74.5	53.5	39.4	...	10.0	...	...	...	...	...	...	...	...	...	...	...	...
12.8	73.3	52.0	38.3	...	13.0	...	...	...	...	...	...	...	...	...	...	...	...
12.7	71.8	50.1	36.8	...	16.0	...	...	...	...	...	...	...	...	151	...	...	...
12.6	70.1	49.2	35.5	...	19.0	...	...	...	...	...	...	...	...	144	118	...	...
12.5	68.4	47.6	34.2	9.5	22.0	0.798	...	187	84.0	72.0	...	...	...	136	109	...	5.54
12.45	67.7	46.9	33.5	11.0	23.6	0.802	...	...	...	...	...	...	...	131	105	...	5.59
12.4	67.0	46.2	32.8	12.5	25.2	0.806	153	185	80.0	66.0	...	...	28.0	127	101	...	5.65
12.35	66.2	45.4	32.2	14.0	26.9	0.810	152	183	...	...	...	...	...	122	97	...	5.72
12.3	65.2	44.7	31.5	15.5	28.6	0.815	150	181	76.0	63.0	42.5	...	29.0	118	93	...	5.79
12.25	64.5	44.1	30.9	17.0	30.3	0.819	148	179	74.0	61.5	38.5	...	...	113	88	...	5.85
12.2	63.7	43.4	30.2	18.5	32.0	0.824	146	177	72.0	60.0	35.5	...	30.5	108	83	...	5.91
12.15	62.9	42.7	29.5	20.1	33.7	0.828	144	175	70.0	59.0	32.5	81	...	103	79	...	5.98
INTERMEDIATE BASE																	
12.1	62.1	41.9	28.8	21.7	35.4	0.833	142	173	68.0	58.0	30.0	75	32.5	98	76	...	6.05
12.05	61.2	41.2	28.2	23.3	37.1	0.837	140	171	66.0	56.5	27.6	66	...	93	70	66.2	6.11
12.0	60.3	40.4	27.5	25.0	38.8	0.842	137	169	64.0	55.0	25.7	57	34.0	89	65	66.7	6.18
11.95	59.5	39.7	26.9	26.6	40.5	0.847	135	167	62.0	54.0	24.0	47	...	83	61	67.2	6.24
11.9	58.8	39.0	26.3	28.2	42.2	0.852	132	164	60.0	52.5	22.6	37	36.5	78	58	67.8	6.30
11.85	58.0	38.3	25.7	29.8	43.9	0.857	129	162	58.0	51.0	21.4	27	...	73	53	68.3	6.37
11.8	57.2	37.6	25.0	31.7	45.7	0.862	126	160	56.0	50.0	20.4	17	38.5	68	49	68.9	6.44
11.75	56.3	36.9	24.4	33.3	47.4	0.867	123	158	54.0	48.5	19.5	7	...	61	41	69.4	6.51
11.7	55.4	36.2	23.7	35.0	49.2	0.872	120	156	52.0	47.0	18.8	— 3	41.0	55	39	69.9	6.59
11.65	54.7	35.5	23.0	36.7	51.1	0.877	117	153	50.0	46.0	18.1	—14	...	49	34	70.4	6.66
11.6	54.0	34.8	22.3	38.5	53.1	0.882	113	150	48.0	44.5	17.5	—24	43.5	44	29	70.9	6.74
11.55	53.1	34.0	21.7	40.2	55.0	0.877	110	147	46.0	43.0	17.0	—34	...	37	24	71.4	6.81
11.5	52.3	33.2	21.0	42.0	56.9	0.892	106	143	44.0	42.0	16.5	—45	46.5	31	20	72.0	6.88
NAPHTHENE BASE																	
11.45	51.4	32.5	20.4	43.7	58.7	0.897	102	140	42.0	40.5	16.0	...	...	24	15	72.5	6.96
11.4	50.6	31.9	19.6	45.5	60.8	0.902	97	136	40.0	39.0	15.6	...	50.0	18	10	73.0	7.05
11.35	49.9	31.2	19.0	47.3	62.8	0.907	92	132	38.0	38.0	15.1	...	...	11	4	73.5	7.13
11.3	49.2	30.6	18.3	49.2	64.8	0.913	87	128	36.0	36.5	14.7	...	54.0	4	— 2	74.0	7.21
11.25	48.4	30.0	17.7	50.1	66.8	0.918	81	124	34.0	35.0	14.4	...	...	— 7	—10	74.5	7.30
11.2	47.6	29.3	17.0	53.0	68.8	0.924	76	120	32.0	34.0	14.1	...	59.0	—18	—18	75.1	7.40
11.15	46.8	28.6	16.4	55.0	71.0	0.929	70	116	30.0	32.5	§12.2	...	...	...	...	75.6	7.50
11.1	46.0	27.9	15.7	57.0	73.2	0.935	63	112	28.0	31.0	§12.0	...	66.0	—60	—60	...	7.61
11.05	45.2	27.2	15.1	59.0	75.5	0.941	56	106	26.0	30.0	§11.8	...	...	...	...	...	7.71
11.0	44.5	26.4	14.4	61.0	77.8	0.947	48	100	24.0	28.5	§11.6	...	...	...	...	...	7.82
10.9	42.8	24.9	13.0	65.2	79.0	0.959	...	89	20.0	26.0	...	...	...	...	...	...	...
10.8	41.1	23.4	11.7	69.5	80.5	0.972	...	77	16.0	23.0	...	...	...	...	...	...	...
10.7	39.4	22.0	10.4	73.7	83.0	0.985	...	...	12.0	20.0	...	...	...	...	...	...	...
10.6	37.8	20.5	9.2	...	...	0.998	...	...	...	...	...	...	...	...	...	...	...
10.5	36.2	19.0	7.9	...	...	1.012	...	...	...	...	...	...	...	...	...	...	...

*Approximate. †The various factors or properties should be determined in terms of the characterization factor. ‡ASTM Motor Method F-2, Des. D. 357. §Based on Far East stock. ¶Midboiling point of fraction.

EXPLANATION OF COLUMNS:

(1) Characterization Factor. Cube root of absolute molal average boiling point (°F. + 460) divided by specific gravity at 60° F., Watson and Nelson, Ind. Eng. Chem., 25, 880 (1933).

(2) Gravities of high-quality gasolines.

(3) and (4) Gravities of USBM Key Fractions No. 1 and No. 2 (Tech. Paper 610) at the arithmetic average boiling points of the fractions.

(5) and (6) Correlation Indexes of USBM Key Fractions No. 1 and No. 2 (Tech. Paper 610) at the average boiling points of ASTM distillations of USBM Hempel fractions.

(7) V.G.C. = [10G—1.0752 log (V—38)] ÷ [10—log (V—38)] in which G is specific gravity at 60° F. and V is Universal Saybolt viscosity at 100° F., Hill and Coats, Ind. Eng. Chem., 20, 641 (1928).

(10) Diesel Index = aniline point (°F.) times API at 60° F. divided by 100.

(12) Smoke point of Institute of Petroleum designation IP57/55.

(13) Ring No. = (Thermoviscosity divided by 5) ÷ [10 (46 minus API)].

(17) Motor Method, ASTM D-357.

(18) Weight ratio of carbon to hydrogen.

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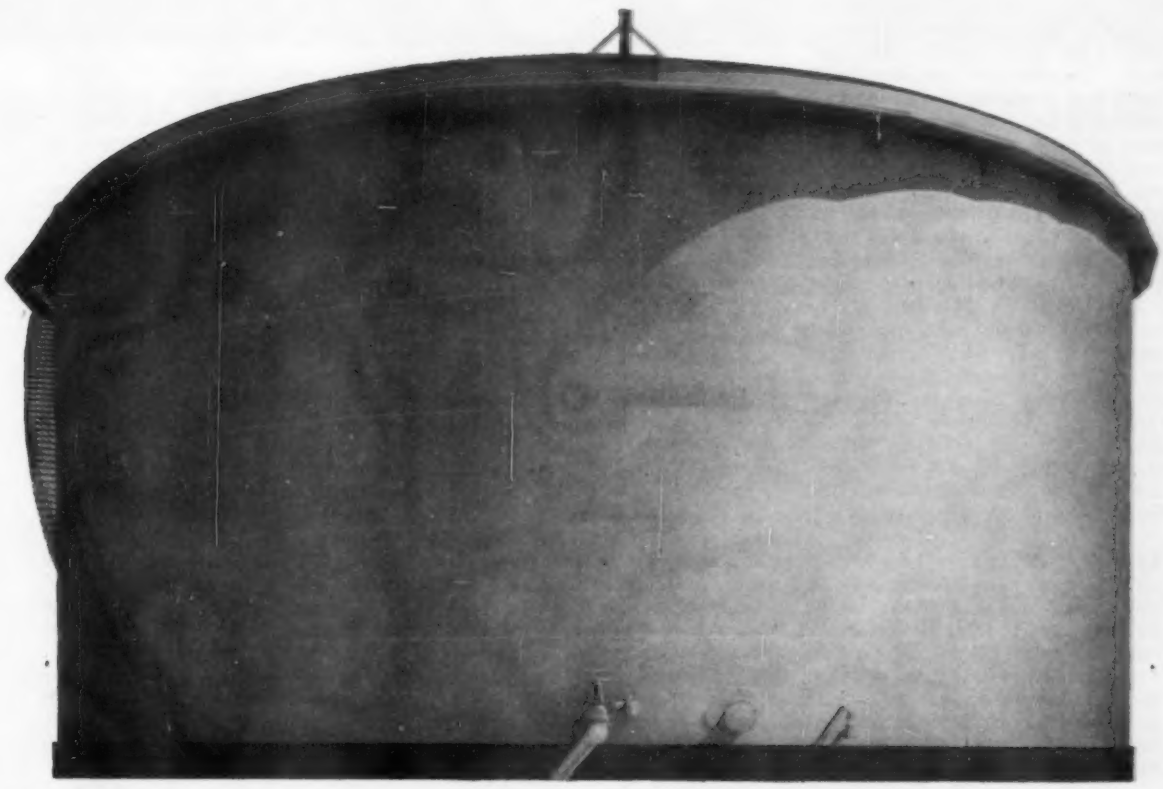

OPERATORS check the wire-line formation tester before lowering it into the well bore. The kneeling man has his right hand on the back-up shoe and his left hand on the pad that is in contact with the zone tested.

HERE the tester is shown "open" with the testing pad and the backup shoe extended. The tool is checked before a test is run to insure that all parts are working properly.

Originally designed for soft formations,

Wire-Line tester tackles hard pay zones

By Norman S. Morrisey
Drilling-Development Editor

MID-CONTINENT production men are turning to the wire-line formation tester as a new method for evaluating possible pay zones. The tool was originally designed for unconsolidated Gulf Coast sands because it is often impractical and too dangerous to test these oil sands during drilling operations with a conventional drill-stem test. The service company, Schlumberger Well Surveying Corp., has redesigned the tool so that it will work satisfactorily in medium and hard formations of the Mid-Continent.

Field results in Oklahoma during the past 3 months have been most encouraging. To date, Schlumberger has run tests in nearly all the important producing zones in Oklahoma (Table 1). Fluid was recovered in 58 per cent of the tests. On the remainder, the tester did not recover sufficient fluid to evaluate fully the formation's producing potential.

TABLE 1—FORMATION TESTER RESULTS

Formation—	No. tests	Some fluid recovered	Positive fluid analysis
Permian limestone	1	1	1
Granite wash	5	5	0
Penn. limestone	7	6	2
Penn. sandstone	38	24	14
Penn. conglomerate	2	1	1
Basal Penn. sandstone	4	3	1
Deese	9	4	1
Miss. limestone	2	0	0
Hunton limestone	3	2	0
Viola limestone	2	1	0
Simpson dolomite	6	3	2
Bromide sandstone	14	11	10
McLish sandstone	1	1	1
Joins sandstone	1	1	1
Arbuckle limestone	2	0	0

Advantages . . . Although the savings over conventional drill-stem tests is not appreciable at shallow depths, the new wire-line tester has many advantages.

- **Rapidity of test:** The unit can be lowered to bottom, can test a zone at 10,000 ft., and can be brought back to the surface in less than 2 hours under normal conditions.
- **Safety:** If a high-pressure zone is tested, there is little danger of a blowout since the weight of the mud is always against the formation during testing operations.
- **Penetrates invaded zone:** The tester normally can get past the invaded zone because the jet shot penetrates 7 in. into the formation tested.
- **Fluid content of zone:** The formation tester takes a sample of the actual fluid content of the zone. Normally it is possible to differentiate between gas, oil, or water.
- **Pin-point accuracy:** The tester evaluates a very narrow zone and it is possible to test within a few inches of the desired interval. This means an accurate determination of gas-oil or oil-water contacts.

How it works . . . The tester is a wire-line unit weighing 750 lb. and is 28½ ft. long in the largest size. One of three different fluid chambers may be used, a 1, 2¾, or a 5½-lb. capacity. The tester is lowered into position opposite the zone to be tested and the pad is expended against the zone making a tight seal between the formation and tester. A jet shot is then fired through the pad into the formation. This forms a flow channel that permits the formation fluid to enter the fluid chamber of the tester. During the test, formation-pressure data are recorded at the surface by electrical circuits.

At the end of the test or when the chamber is filled, the tester records the shut-in pressure and the hydrostatic head. It is usually necessary to fire a cartridge shot to free the pad after it is collapsed. As a safety measure the tool has a second cartridge in the event the first fails to free the pad.

The tool is quickly brought to the surface and the fluid in the chamber is analyzed on the spot. Drilling fluid, formation water, oil, and gas are readily identified.

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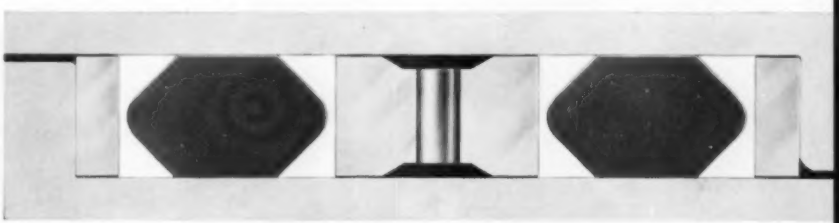
This cross-section shows how nylon back-up rings expand to provide zero clearance and perfect containment of packing elements when tightened. The metal end ring restores worn shoulders—adding reinforcement to the nylon. The result is long life with minimum adjustment.



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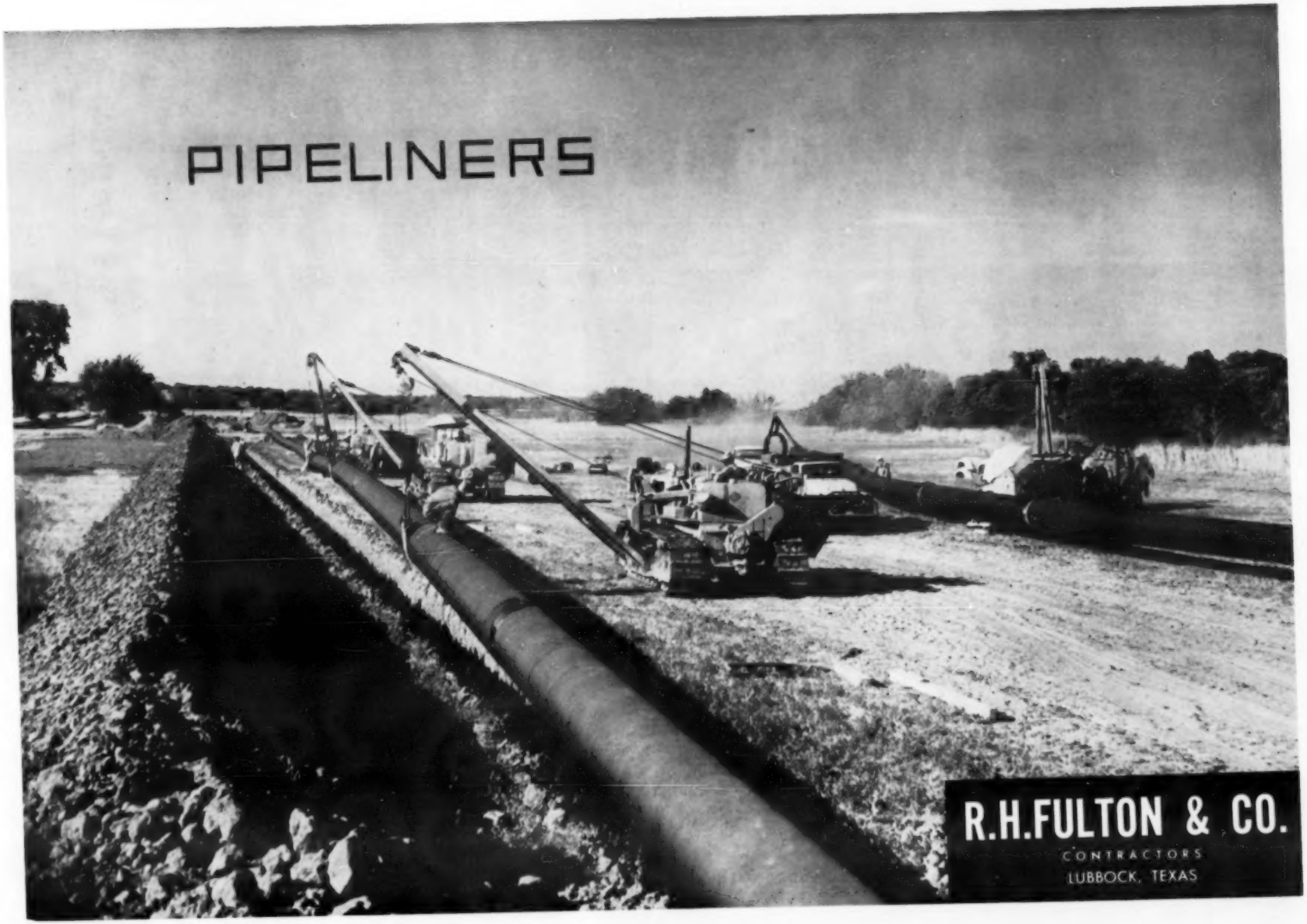
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Don't overlook air cleaners—here are some tips to make sure your . . .

Cooling-system maintenance pays off

By Dan Haack
Mid-Continent Pipe Line Co.

ANOTHER item that is exceedingly important, but often overlooked, is the carburetor air cleaner. Here again, the purpose is to show how good maintenance can extend engine life and prevent excessive wear and breakdowns.

Tests made shortly after World War II by a major engine builder proved that only 8.3 oz. of abrasive dust will wear out an 815-cu.-in. displacement (70-hp.) engine in 50 hours. Thus, less than one-half of a thimbleful can ruin a $4,000 engine. Also, it does not matter how long it takes to put this dust through. Whether in 10 hours, 100 hours, or 10,000 hours, when this much abrasive has gone through the air intake, the engine is worn badly enough to cause spark-plug fouling due to high oil consumption.

It might be thought that this is a large amount of dust, but it would not take long to accumulate that much when you consider that an engine of this size takes in about 24,000 cu. ft. of air per hour. I have examined piston rings which were worn so thin in only 8 hours of operation that I could snap them in two with my fingernails. So severe was the wear on rings and cylinder walls that this engine couldn't be restarted due to low compression. You can see from these examples that an air cleaner can literally be the life of an engine in dusty areas.

Dry-Type Air Filters

A recent development is the dry-type paper-element filters which have been introduced principally on the new automobiles and trucks. We have no tests under way on these cleaners, which are claimed to be reasonably efficient under some conditions. However caution should precede selection of paper-type filters for industrial use. They do not have a large dirt-holding capacity, and will clog rapidly if exposed to soot or moisture. There is also a record of one of these cleaners catching fire due to the engine backfiring. This could not happen on an air oil-bath cleaner because the metal oil-bath screen acts as a flame arrester.

Automatic or self-cleaning air cleaners operate on the inertial or cyclone principles and are designed for engines which run unattended for long periods. They have been tested by Standard Oil Co. of California and others on so called long-run engines which operated unattended from 6 months to 1 year. Multiple-tube separators change the incoming air into a high-velocity vortex which centrifuges the dust into a discharge hopper. Dump valves which are actuated by slight pressure or vacuum, periodically empty the accumulated dirt. Reports differ on the effectiveness of these automatic air cleaners. It appears, however, that the air velocity through them is a very critical factor, and therefore selection of correct size for the engine displacement and speed assumes great importance. We are watching the development of these filters with interest, as they promise to fit in well with the trend toward automation.

Oil-bath air cleaners are the type most commonly found on oil-field engines, and if cleaned and serviced properly will remove from 92 to 99 per cent of the atmospheric dirt. Where severe dust conditions prevail, collector-type precleaners are desirable, and will increase the efficiency of the filters.

Maintenance and Operation

Although differing in type, arrangement, and size, the cleaning periods and procedure for all oil-bath air filters are basically the same. An inspection of the oil reservoir for accumulated dirt and sludge will indicate the proper cleaning interval on small air cleaners. On large air cleaners the pressure drop across the filter as indicated by manometer test will pinpoint the interval. (Three inches of water column is the maximum drop allowed.) These cleaning periods may range from daily to once every 90 days, depending on the condition of the atmosphere.

Avoid servicing an air cleaner while the engine is running because on some models the operating level of the oil is lower than the stationary level. Too much oil might cause the carburetor fuel mixture to be leaned out, resulting in such things as burned valves. On the other hand, too little oil will result in more dust getting through. The performance of the oil-bath cleaner also depends on the oil in the sump. Use only the type and viscosity specified by the manufacturer.

The practice of using crankcase drainings in the oil reservoir is poor maintenance, because small carbon particles and other impurities may clog the filter screens. After prolonged use, oil in an air cleaner may need changing due to thickening, even though there is no visible dirt or sludge. This is due to the accumulation of fine lint which thickens the oil.

Why Good Maintenance Pays

Maintenance savings have the same economic implication as investments for increased expansion. For example, a 1 per cent saving in maintenance costs can present a better payout than the capital expenditure required to provide facilities for the same increase in capacity. In other words, maintenance expense dollars saved are gross profit dollars made. It should not be assumed that the lowest maintenance costs always reflect the best maintenance program, however. A piece of equipment which is laid up for a long period of time waiting for repairs does not acquire much maintenance cost, but neither does it bring in any revenue.

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On the Job

PIPELINING

program by the application of the principles discussed. For example, we have a number of engines which have passed, or are approaching the 40,000-hour mark without showing signs of needing major overhaul. This would be equivalent to 2 million road miles on a mobile unit. This further represents between 4 and 5 years of practically continuous around-the-clock operation. One of these 220-hp. gas engines, for example, has produced power during that time equivalant to 6,572,418 kw.-hr. At present commercial electric rates of 8 mils per kw.-hr., that much energy is worth $52,480. This gas engine which cost about $10,000 when new has therefore made a very favorable return on the investment when it is considered the machine is capable of indefinite continued operation. Only a few years ago we considered 18,000 hours a good run. Now we are shooting for 50,000 hours between overhauls.

By way of comparison with other users of the same type of engines, I quote in part from a letter by the manager of a large engine-overhaul shop.

"As we check over the maintenance work performed for your company over the last 5 years, it appears that only one engine has been in our shop more than once during this period of time . . . In my visits to several of your pipeline stations, I have checked the number of hours your engines are operating between overhauls, or bearing replacement, and it appears to me that you are exceeding by several thousand hours any other installation covering these particular models. I feel you have made a lot of progress in the last 5 years in cutting your regular repair bills by your good maintenance program . . . "

Of course, we don't give all the credit for this good record to cooling-system and air-filter maintenance alone. Improved lubrication, ignition, oil filtration, and better metals have all played an important part. Another secret of these long runs is that some of the best engine-overhaul facilities in the nation are available to us in Oklahoma City and Tulsa. The maintenance services of these shops have been the very best obtainable anywhere. Our factory and dealer service has also been excellent, and our engine troubles have always been met with prompt and helpful consideration. All these factors have made the long run records possible.

There is one factor, the human element which has not been considered thus far. Human nature has a tendency to follow the line of least resistance—to take short cuts, or otherwise avoid the close attention to detail so essential to a successful program. Without systematic and planned maintenance, however, all work becomes emergency work, and you can only proceed from crisis to crisis. The resulting loss of efficiency from wasted man-hours and hasty repairs is prohibitive to anyone expecting to stay in business.

By following the methods and procedures outlined here, we have made real progress in reducing our operating costs and keeping our machinery in top condition. At the same time we have protected our original engine investment and subsequent overhaul investments. No better insurance could be had. A few of these accomplishments are as follows:

1. Cut winter antifreeze costs from 60 to 80 per cent by using ethylene glycol solution containing sodium chromate continuously for 4 and 5 years. There is some controversy about this practice, but our successful operating records are the proof of the pudding. as far as we are concerned.

2. Improved engine lubrication, and reduced filter and crankcase drain frequency. In one particular instance we operated a 300-hp. engine for 11,000 hours without a crankcase drain being necessary. This would not have been possible without good temperature control and air-filter maintenance.

3. Complete elimination of wet-cylinder sleeve corrosion and pitting. The piston bores of these liners can be chrome-plated over and over, and there is no foreseeable limit to the life of such parts.

Conclusion

In summation, the following precautions in operating your industrial engine are emphasized:

1. Use only clean, mineral-free water in the cooling system to prevent scale. Where only hard water is available a water-softening treatment should be applied. When hard water must be used as-is, zinc anodes of the electrolytic type may prove helpful. Drain and refill hard-water solutions frequently to prevent the mineral content from being concentrated due to evaporation losses. Reduce causes of evaporation as much as possible. Remember that water conditioning and chemical treatment in one form or another will solve all cooling-system troubles.

2. Use a good corrosion inhibitor such as sodium chromate the year around under any and all conditions,

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and replenish it at regular intervals to hold the pH between 8.5 and 9.0, and the concentration at 1,000 p.p.m. (2 oz. per each 4 to 6 gal.).

3. Regulate operating temperatures carefully to keep engine lube oil from dropping lower than 140° F. or climbing over 200° F. Use thermostats, oil coolers, shutters, and any other devices which will keep this temperature range from being exceeded.

4. Install a suitably designed oil-bath air cleaner on all engines, and keep it properly serviced.

5. Plan your maintenance program carefully, and tailor it to fit your individual needs—then stick to it.

If these procedures are correctly carried out, while at the same time other good maintenance and operating practices are followed, maximum return on the investment is assured.

Acknowledgment

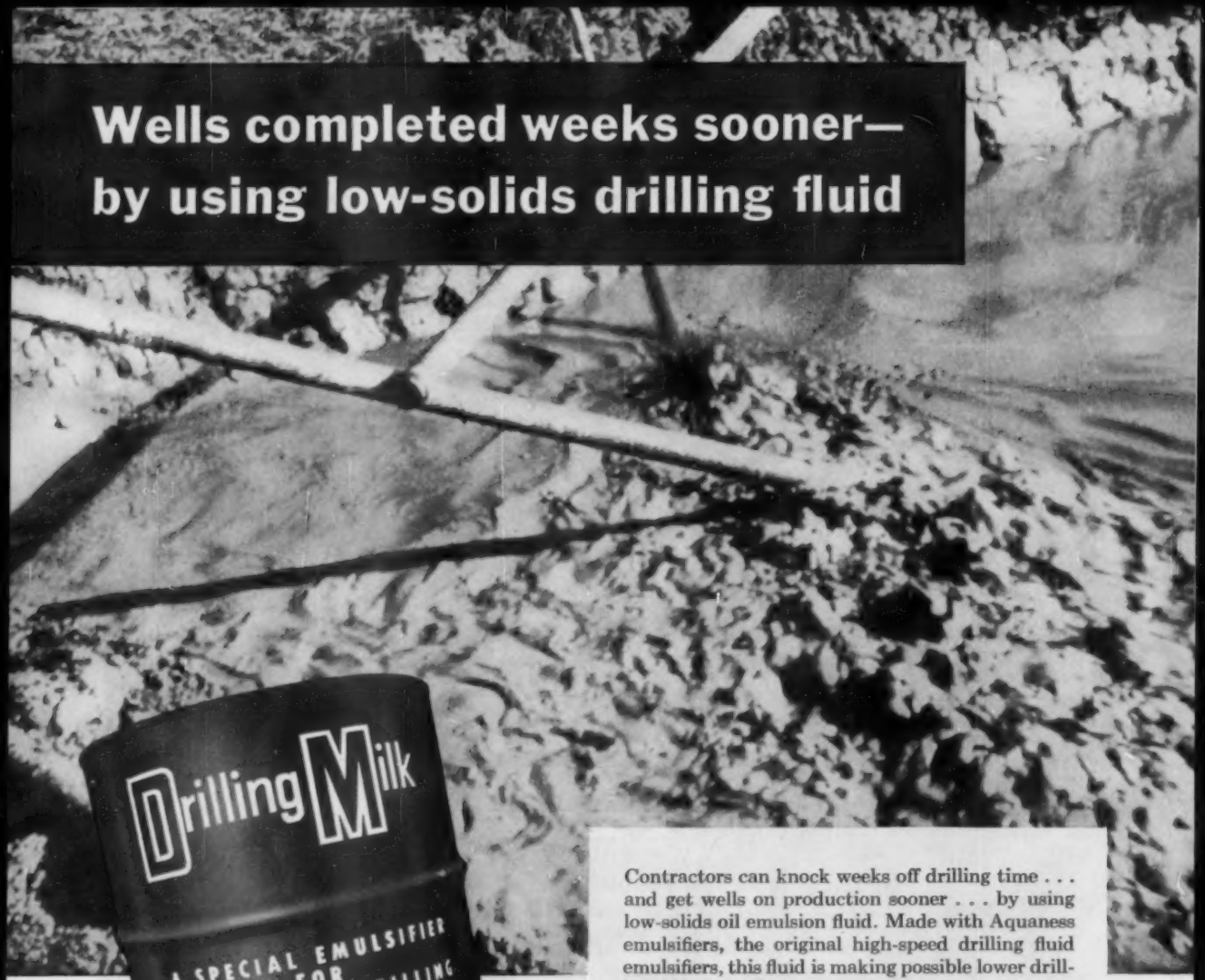
The author wishes to express appreciation to Alva C. Smith, superintendent of the mechanical department, Mid-Continent Pipe Line Co., for guidance in making this article possible.

CORRECTION

The label for the abscissa of Fig. 5, "Eductor Mixers for Mixing Liquids in Fixed-Roof Tanks," page 88, October 28 issue, is erroneous. This should read "Suction port flow g.p.m. per square inch of orifice area."

"No, that was Home, Sweet Home—now see if you can guess this one."

Wells completed weeks sooner— by using low-solids drilling fluid



Contractors can knock weeks off drilling time . . . and get wells on production sooner . . . by using low-solids oil emulsion fluid. Made with Aquaness emulsifiers, the original high-speed drilling fluid emulsifiers, this fluid is making possible lower drilling bids, with fair profit to contractors. It has been used with outstanding results in over 500 wells.

PENETRATION RATES INCREASED. Tests on offset wells show low-solids fluid boosts penetration rates from 26 to 41%.

TRUER GAUGE HOLE DRILLED . . . less cement required.

MUD CONTROL SIMPLIFIED. Solids drop out quickly. No foaming. Minimum mud service. Mud flows like water; viscosity can be easily controlled. Faster mud conditioning.

LOST CIRCULATION REDUCED. Weights are lighter; pressures are lower.

LARGER CUTTINGS. Better for geological analysis.

SALT AND AIR CORROSION RETARDED by excellent inhibiting properties of this fluid.

ASK YOUR MAGCOBAR DEALER ABOUT DRILLING MILK*

. . . or write to Magcobar about this emulsifier for low-solids fluids.

*Trademark Magnet Cove Barium Corporation.

LOOK FOR THE AQUANESS SEAL

It identifies the **original** *low-solids, high-speed drilling fluid emulsifier, made by Aquaness for leading mud companies.*

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- Easily run and set on wire line, tubing or drill pipe
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BAKER WIRE LINE BRIDGE PLUG PRODUCT NO. 400-N

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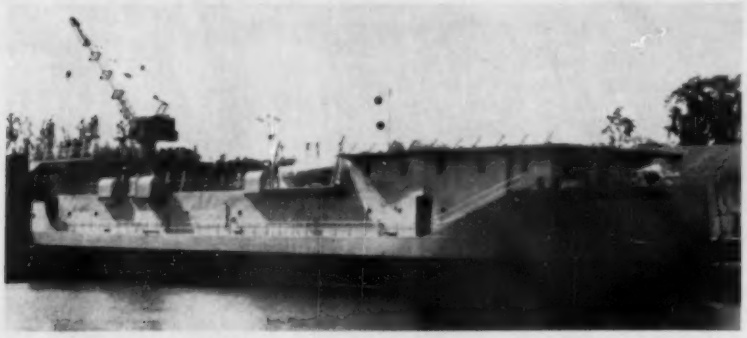
Among the Drilling Contractors



SEA-BOUND—An-Son Drilling Co.'s newly completed diesel-electric drilling tender

An-Son Extends Drilling to Offshore Development

An-Son Drilling Co., Oklahoma City, is expanding the scope of its operations with the addition of a diesel-electric drilling tender for use offshore in the Gulf of Mexico.

It already is operating three rotary rigs in Oklahoma, an inland drilling barge in South Louisiana, and three rotary rigs in Colombia, South America.

The new tender, commissioned the Carl B. Anderson, will be operated by an affiliated company, An-Son Gulf Drilling Co., of which Carl B. Anderson, Sr., is chairman of the board; his son (Carl B., Jr.), president; and George B. Troxwell, Jr., vice president.

It was designed for use in conjunction with a minimum-type platform only 90 ft. by 60 ft. Built in the yards of Equitable Equipment Co., Inc., at New Orleans, it is 250 ft. long with a 50-ft. beam and a moulded depth of 15⅜ ft.

Its diesel-electric power facilities were provided by Alco Products, Inc. Equipment on the tender consists of two Alco "251" engines, each rated at 850 hp.; three 550-kw. d.c. generators; two 250-kw. a.c. generators; and four 625-hp. d.c. motors. Power equipment to be located on the drilling platform includes a packaged emergency engine-generator unit of the same size as each of the two on the tender, the two draw works motors, and the main and auxiliary control cabinents.

Two decks contain living quarters for 44 men. The lower deck contains galley, dining room, showers, and sleeping quarters. The upper deck has additional sleeping quarters, recreation room, offices and quarters for engineers and geologists. Top deck has a heliport, and communications equipment. The middle deck has a bulk mud storage bin for 3,500 sacks of mud, and a three-compartment bin for cement storage. The third deck has storage tanks for 13,000 bbl. of drilling water and 24,000 gal. of diesel fuel.

Falcon Seaboard Drilling Co., Tulsa, has a rig working for Gulf Oil Corp. at a wildcat location 8 miles southwest of Belvidere, in southern Kiowa County, Kansas. Drilling is projected to the Mississippian about 5,150 ft. Location is for 1 Moberly, in 31-30-17. It is about 2 miles north of the Comanche County line. Nearest production is in Glick field, 5½ miles east.

Sooner Well Service Co. has taken a 7,500-ft. drilling job in northern Refugio County, South Texas. It is a wildcat test for C. C. Winn, of San Antonio, at 1 Baumgartner. Location is about 5 miles north of Vidauri, in the J. & J. J Garcia and J. Vidaurri Survey.

Woolf & McGee, Inc., Tyler, Tex., will drill a 7,500-ft. Wilcox test about 10 miles southeast of Alexandria, in eastern Rapides Parish, Central Louisiana. It is a contract job for Roger J. Bassett on his Lee Lumber Co. lease, in 17-3n-2e. Nearest production is in Big Island field, about 10 miles northeast.

Texon Drilling Co., Corpus Christi, Tex., is on a new wildcat operation

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If mud gets to your joint threads, it can wash out a string in a hurry. 'Bestolife Lead Seal Tool Joint and Casing Compound gives maximum, tight joint make-up, keeps mud out. Standard of the oil country for over twenty-five years. Unconditionally guaranteed. Packed in 1¼, 5, 20 and 50 lb. containers. Sold by leading supply houses throughout the world.

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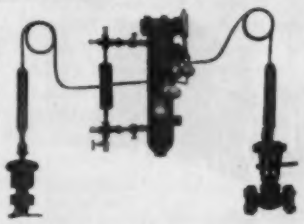

INFERNO Boiler Safety Units furnish complete AUTOMATIC safety three ways: by keeping proper water level, by blowing a whistle if water supply fails, and by cutting off fires if whistle is ignored. Write today for your free copy of Bulletin No. 15-C.

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Chance Expanding Anchors are highly efficient anchors where permanent guying is needed for drilling and service rigs and derricks. They can be installed in a fraction of the time required for burying old pipe or setting concrete "deadmen". Installed quickly and easily, the Chance earth anchor will hold up to 30,000 pounds in firm ground.

Write for catalog showing oil industry applications of Chance Earth Anchors.

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7 miles east of Driscoll, in Neuces County, Lower Texas Coastal District, where it is drilling for Pontiac Refining Co. Location, at 1 Stephenson, in Section 8, Roberts & White Subdivision of the Hoffman Petronilla Ranch, is about 3½ miles southwest of Ramada field. Permit is for a 7,600-ft. test.

Glasscock-Wilson, Inc., Shreveport, is working on a new deep contract job in southwestern Allen Parish, South Louisiana. It is a projected 9,400-ft. test for W. Earle Rowe, of San Antonio, on a Ragland Lumber Co. lease. Location is about 3 miles from production in Clear Creek field, on the Allen-Beauregard parish line.

Continental Drilling Co., New Orleans, will drill a deep test for F. A. Callery at a wildcat location east of Bayou Pigeon field, in the eastern arm of Iberia Parish, South Louisiana. Callery took a permit for a 12,500-ft. test, which will be drilled as 1 Brownell-Kidd with spot location in 18-12s-11e.

Pernie Bailey, Houston, has taken a 10,500-ft. contract in northwestern Acadia Parish, South Louisiana. Operator is Cyprus Oil Co., whose location, on its Joseph Klumpp lease, in 17-8s-2w, is about 3¼ miles west of Iota field, and about the same distance southeast of West Tepetate field.

T. J. Johnson Drilling Co., Tyler, has another new contract operation in southern Anderson County, East Texas. It is a 6,000-ft. Woodbine test for W. H. Bryant, also of Tyler. Location is about 5 miles northwest of Slocum at 1 Lasiter, in the D. L. McKelvaine Survey.

Jett Drilling Co., Inc., Shreveport, is getting under way on another Cotton Valley test in the Carlton area, 2 miles north of Calhoun, in Ouachita Parish, northeastern Louisiana. It is drilling for Sunray Mid-Continent Oil Co., whose location, at 1 Brooks, in 15-18n-1e, is about 2 miles southwest of W. C. Feazel's discovery well in the area. The latter is productive of gas and condensate from the Cotton Valley-Bodcaw zone at 9,048-64 ft. Sunray's test has a 9,700-ft. permit.

Twin Drilling Co. is contractor on a rank wildcat test D. E. Dunn, Jr., is putting down 13 miles west of Jetmore, in western Hodgeman County, western Kansas. It is a 4,900-ft. Mississippian test at 1 Conder in 2-23-26. Nearest production is in Hallett field, 6 miles northeast.

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MINIMUM HARDNESS

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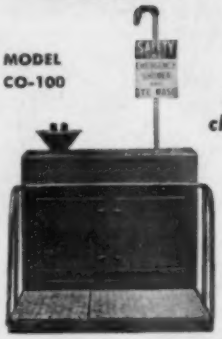

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Combination non-freezing overhead shower and eye bubbler independently activated by aluminum platform treadles.

Write for illustrated folder showing other showers, strainers, figure "8's", retractable spray nozzle assemblies, etc.

Above—Spade Flange, Spacer Ring and Figure "B" for raised face flanges. Also made in ring type joint style in all metals and pipe sizes.

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Dependable service means that you get the materials you want at your well when you want them. It means that your Magcobar dealer has everything in his warehouse to meet any mud problems that may arise. Magcobar's own strategically located warehouses back up the dealers in case of unusual or abnormal demand.

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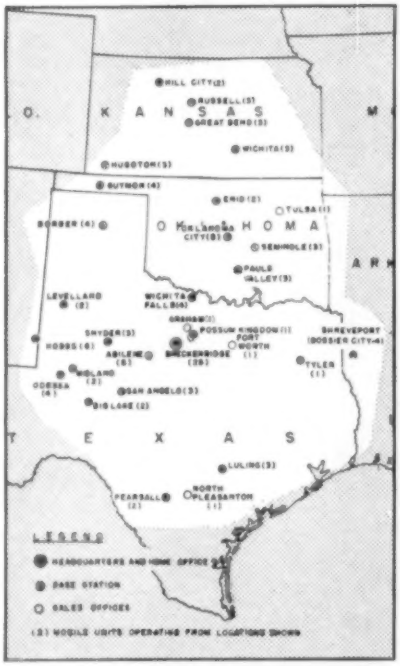
Chemical Process speeds oil field service in 5 states



Chemical Process' G-E radio system has grown right along with the company. Today it includes 25 base stations and 106 mobile units. Authorized General Electric service stations provide complete coverage in the field.

Overhead cut with General Electric two-way radio

Chemical Process Division of BJ Service, Inc. treats about 11,000 wells a year in five states. "Our rolling stock drives 500,000 miles or more a month and I don't see how we ever did without radio," says Mr. E. C. Burnett, Supt. of Communications.

One of the earliest users of General Electric two-way radio, Chemical Process knows how economical General Electric radio is to maintain. The new Progress Line with plug-in chassis saves them even more money through faster servicing. Either a transmitter or receiver can be replaced in five minutes right in the vehicle, using only a screwdriver. And with 50¢ worth of parts, you can even change from wide to narrow band reception (pioneered by General Electric).

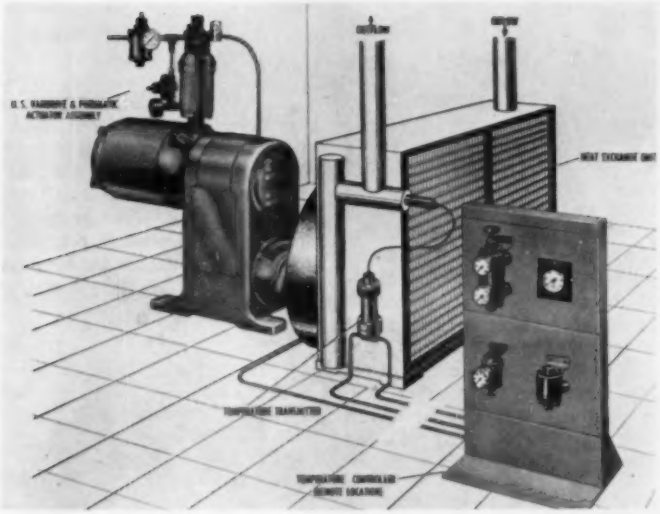
Only General Electric gives you plug-in chassis, dependable communication-type tubes and controlled reluctance microphones for sharp voice transmission—*all at no extra cost.*

Look for your G-E communications consultant under "Radio Communications Equipment" in the Yellow Pages, or write: General Electric Company, Communication Products Dept., 18127-2, Syracuse, N. Y.

GENERAL ELECTRIC

SHOWCASE...

NEW EQUIPMENT



Heat-Exchange Processes Controlled

Heat-exchange processes are regulated automatically with this new system. It consists of a U.S. Varidrive equipped with an automatic control, a temperature-sensing transmitter, and a control panel. Completely automatic, the system holds the desired product-output temperature within 1 per cent of the desired value, the maker says, by varying the speed of the driven fan or pump.

The system provides accurate control and is designed to give prolonged performance with little attention. It may be used with heat-exchange systems operating at pressures up to 1,000 psi.

The temperature transmitter is provided for installation at locations convenient to the process site. It supplies the required input signal for the control panel.

A gas-filled bulb in the transmitter senses the desired temperature. It then generates a proportional pneumatic signal to the automatic control on the Varidrive. Thus the Varidrive slows down or speeds up, depending upon the required correction, altering the speed of the driven fan or pump. The temperature bulb of the transmitter is constructed of stainless steel, permitting its use in a variety of materials. **Write or call: U.S. Electrical Motors Inc., Box 2058 Terminal Annex, Los Angeles 54, for Specification Sheet Section 351, page 17, and Bulletin F-1882.**

New Load-Cell Unaffected by Vibration

Smooth operation under such adverse circumstances as shock-loading and/or continuous vibration is offered by the new tension and compression load-cell system, the maker reports. A hydraulic diaphragm incorporated into the system operates without friction and eliminates the

troublesome maintenance usually present with O-rings and other hydraulic seals, the maker claims.

No external power source is required. The load-cell systems are

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to the **Manufacturer** of the item in which you are interested. See name, address, and equipment name and/or model, in bold-face type at end of description.

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Described in OIL AND GAS JOURNAL - Issue of December 2, 1957

NAME.....TITLE.....

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ADDRESS.....

CITY.....STATE.....

DATE.....

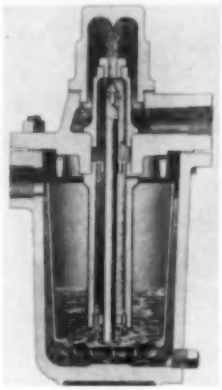
New Equipment

loaded and sealed at the factory. Both have a 360° calibrated gage and a 25 per cent tare adjustment, on a 12-in. dial. One feature cited for the systems is automatic self-alignment of the cell under load (up to 4° misalignment will not affect indication). Both remote or unitized applications of a wide variety of load-measuring operations are possible. **Write or call: Martin-Decker Corp., 3431 Cherry Ave., Long Beach 7, Calif., for details on load-cell systems.**

●

Steam Trap Has Rotating Valve

The valve assembly comprises a bucket, a valve, and an impeller. These operate as an integral unit which is the only moving part in the trap.



Simple preventive maintenance is made possible by the convenient removable cap, permitting inspection of the valve and seat without disturbing high-pressure bolts or gasket. **Write or call: H. O. Trerice Co., 1420 West Lafayette Boulevard, Detroit 16, Mich., for details on Trerice steam traps.**

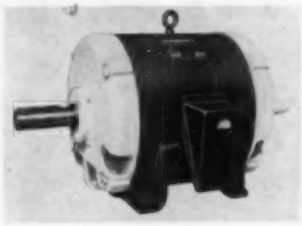
●

Motor Designed for Oil-Well Pumps

A meter on the motor shows if pump operates properly. The new electric pumping motor is designed exclusively for oil-field pumping, the maker reports. Designated as the C-E Green Triangle electric pumping motor, it incorporates several features.

By glancing at the needle of the balance meter built into the motor, a pumper can see if the well is pumping satisfactorily and economically. The meter also gives an accurate gage for balancing the well.

Motor specifications include a 5 to 8 per cent slip, 275 per cent starting



torque, and a 40° C. rise. The motor has a guaranteed 1.15 service factor. According to the maker, the motor's design assures cushioned peak demands and added protection to gears, belts, bearings, and well equipment.

Two shaft extensions are employed on the motor, making it flexible and easy to install. The motor drives from both sides and rotates in either direction, and leads can enter either side.

The pumping unit can be driven from one shaft extension and the other extension used for auxiliary equipment.

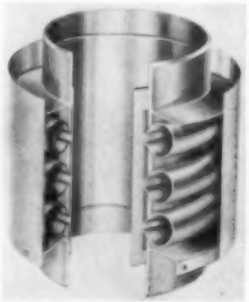
The hold-down bolt holes on all motor sizes measure 21/32-in. This feature allows the bolts furnished with pumping units to be used, regardless of their make or the manufacturer.

Operating at 1,200 r.p.m. (synchronous), the motor comes in ratings of 3 to 30 hp. **Write or call: Continental-Emsco Co., Div. of Youngstown Sheet & Tube Co., 608 Continental Building, Dallas, for details on Green-Triangle pumping motor.**

●

Expansion Joint Hydraulically Formed

Circumferential welds eliminated on this joint employing a patented toroidal corrugation design. Known as the Zallea HyPTor expansion joint,

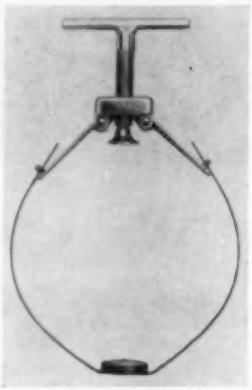


the unit protects power and process piping systems and related equipment against damage from expansion and contraction due to temperature change.

The toroidal corrugations have circular or oval cross-sections. For any given pressure, they produce relatively low operating stress. The thin-walled bellows reduce flexing stresses and substantially increase expansion-joint life, the maker says.

The corrugation roots are fully supported without welding. Only the concave part of the corrugation is exposed to pressure. An external cover protects the corrugations from accidental damage. The expansion joint is usually made from stainless steel in 6-in. sizes and larger for pressures up to 2,000 psi. Joints of other materials and for higher pressures are available too. Either flanged or welding connections can be had. **Write or call: Zallea Brothers, 815 Locust Street, Wilmington, Del., for details on toroidal expansion joints.**

●

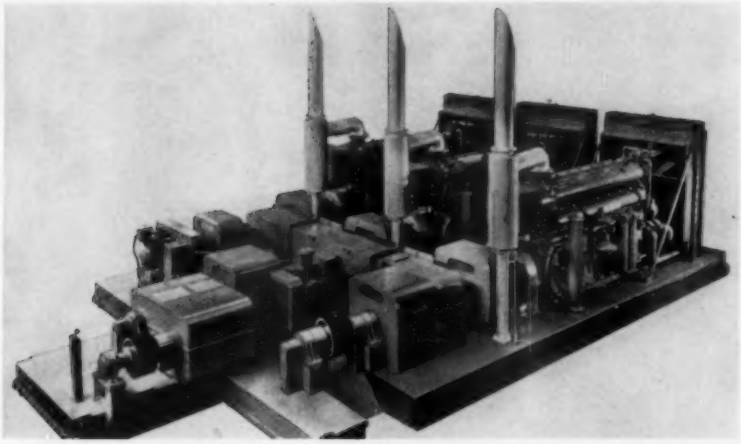


Strap-on Clamp Stops Pipe Leaks

The assembly is especially designed to stop leaks before affixing and welding the shoe to the damaged pipeline. Made of pliable Neoprene rubber, the plug is laminated to a ⅞-in. perforated-steel strap. A steel disk supports the back of the plug.

According to the maker, the plug gives an immediate tight seal under extreme conditions of corrosion and rust. Its pliable softness allows it to flow readily into all cavities, pits, holes and cracks. Yet, it's tough enough to prevent it from being cut or torn by high line pressure.

The perforated steel-bar strap allows fast and simple assembly to any pipe size. It's available in a 24-in. length for pipes with an 8-in. or smaller diameter and a 36-in. length for pipes with up to a 12-in. diameter. For pipe over 12-in., a splice is used for additional length. **Write or call: D. W. Moor Rubber Corp., Wapakoneta, Ohio, for details on strap-on plug and clamp.**



Drive Group Designed for Deep Drilling

The new Type B 1¾ in. quad.-series drive group is designed for deep-drilling programs requiring engines rated above 525 hp. using hydrodynamic drives and for mud pumps with 1,000 input hp. or greater. It incorporates either fluid drives or torque converters.

This new series provides the advantages of factory prealignment, easy portability, and quick, easy rigging up, the maker states.

The sections can be adapted to any engine make of appropriate power. Air-operated controls at the driller's position include those for engine throttles, engine clutches, pump-drive clutches, master clutch, and inertia brake. Master and pump-drive clutches are dual 28 by 5¼-in.

The engine sections are compounded either in pairs or in multiple-section groups by sliding gear-tooth clutches. These engage compounding sprockets mounted on roller bearings. Mud-pump driving arrangement alternates include those for one, two, or three slush pumps, and single or two-speed pumps, offset or side by side. **Write or call: National Supply Co., 2 Gateway Center, Pittsburgh, for details on sectional drive pumps for consolidated drilling rigs.**

●

Oil Field Engine Is Maintained Easily

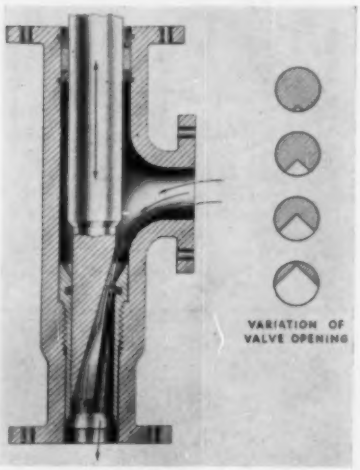
This new 25-hp. F-25 engine is not only suited for around-the-clock service on medium to deep-well pumping but also for water-flood applications, the maker states. Its recommended continuous horsepower range is 15.7 to 25 hp. at speeds from 350 to 625 r.p.m.

The engine is equipped with a heavy, symmetrically machined flywheel, large counterbalanced crankshaft, forged-steel connecting rod, pressure-lubrication system with built-in oil filter, and mechanically operated inlet and exhaust valves. These features result in a well-balanced engine throughout its operating speed range, the maker says.

Optional accessories consist of (1) safety shutdown switches for low oil pressure and low water level, (2) gas-fuel regulator valve, (3) structural-steel subbase to clear flywheel, and (4) a 12-volt electric-starting system. **Write or call: Witte Engine Works, Oil Well Supply Div., United States Steel Corp., 1614 Oakland Avenue, Kansas City, Mo., for details on F-25 engine.**

Valve Uses Tapered Orifice

This tapered-orifice valve offers a new concept of flow control, the maker reports. By moving a plug with a tapered slot into and out of a circular opening, the flow of fluid or gas is controlled by the area of the tapered slot at the head of the opening. A circular sealing ring eliminates bypassing. The tapered-orifice valve will pass foreign particles up to 20 times larger than comparable needle valves, the maker claims.



Principal advantages cited are: (1) high accuracy; (2) infinitely variable control; (3) nonclogging and nonfreezing; (4) abrasion-resistance; and (5) excellent coefficient of flow at all settings with low turbulence. **Write or call: General-American Valve Co., P. O. Box 444, Corona Del Mar, Calif., for details on tapered orifice valve.**

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ADDRESS.....

CITY.....STATE.....

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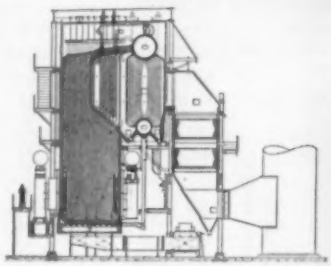
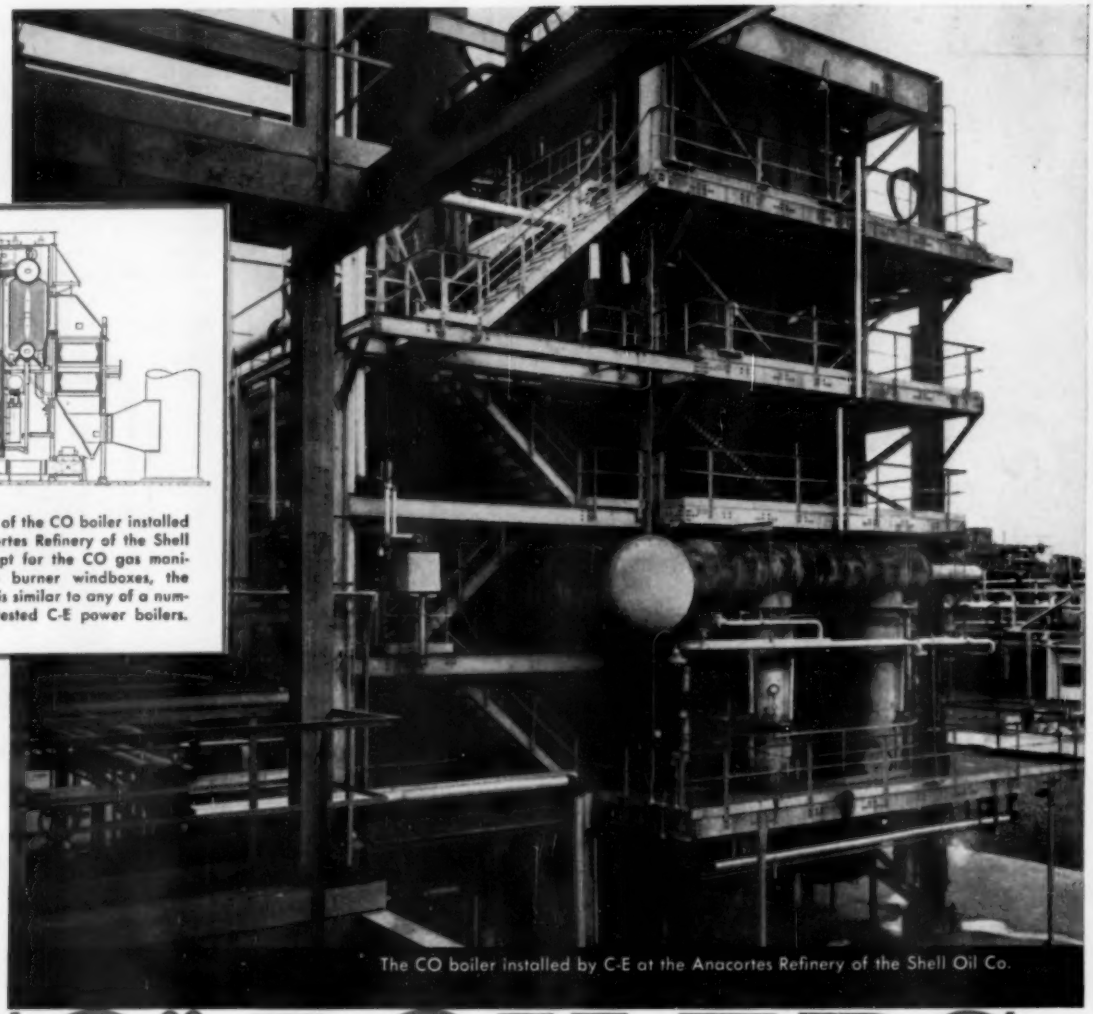


Cross section of the CO boiler installed at the Anacortes Refinery of the Shell Oil Co. Except for the CO gas manifolds to the burner windboxes, the cross section is similar to any of a number of time-tested C-E power boilers.



The CO boiler installed by C-E at the Anacortes Refinery of the Shell Oil Co.

"CO" BOILERS

Advanced in Design · Tangentially Fired

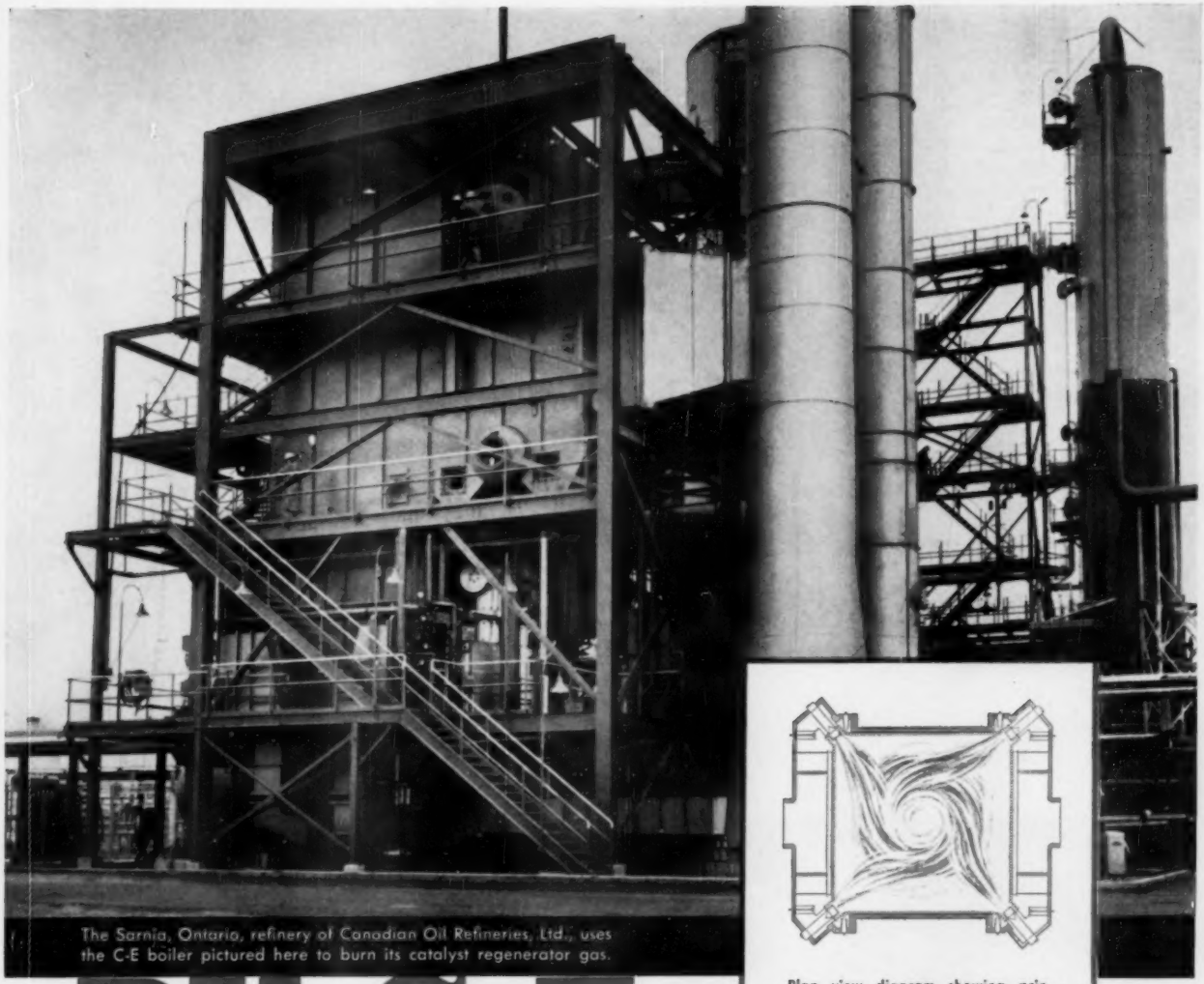
All CO boilers by C-E are of advanced design, yet conventional in appearance. They require no specialized and complicated device to burn the lean, moist and toxic gas from a catalyst regenerator. Rather, they use the time-tested principle of tangential firing—a principle ideally suited for use with lean fuels. Located in each of the four corners of a conventional furnace, each burner directs layered streams of CO gas, supplemental fuel and air to a small imaginary circle lying in a horizontal plane in the center of the furnace. These streams impinge on each other, and the

COMBUSTION

Combustion Engineering Building

CANADA: COMBUSTION ENGINEERING-

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;



The Sarnia, Ontario, refinery of Canadian Oil Refineries, Ltd., uses the C-E boiler pictured here to burn its catalyst regenerator gas.

Plan view diagram showing principle of tangential firing in a completely water-cooled furnace. Air ducts, dampers and ignition torches are indicated.

BY C-E

Double Steel Cased · Service Proved

lean gas begins to burn immediately upon entering the furnace. Because of the intense turbulence and the length of the horizontal flame travel, combustion is completed within a short vertical distance in the furnace.

In terms of general experience, a total of more than 675 tangentially fired C-E boilers have been purchased to date. As to specific experience with lean fuels, C-E—in addition to its CO boiler installations in refineries—has installed more than 150 boilers burning blast furnace gas . . . a fuel similar to CO gas with a heating value of about 80 btu per cubic foot.

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PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

SHOWCASE . . .

New Literature

Porous, Sintered Stainless-Steel Filters are described and illustrated in new Catalog 54-101. The 12-page catalog provides characteristics, application data, and specifications on the line. A selector chart with instructions plus filtration-data tables are added features that help in filter selection. **Write or call: Cuno Engineering Corp., Meriden, Conn., for Catalog 54-101.**

●

Carbon and Graphite Products for petrochemical processing and other industries are illustrated in new four-page Bulletin S-5008. Including both National carbon and graphite and Karbate-brand impervious carbon and graphite products, the bulletin lists the chemical and physical properties that make them suited to chemical processing and other similar applications. It provides data on shell-and-tube heat exchangers; cascade, concentric, and immersion type of heat exchangers; centrifugal pumps; entrainment separators; pipe, valves, and fittings; towers and accessories; and brick, structural shapes, and cements. Other products discussed are anodes and backfill for cathodic protection; electrolytic anodes; and activated carbon. Also covered are phosphoric acid systems; sulfuric acid diluting equipment; pump injectors and ejectors; porous carbon and graphite; hydrochloric falling-film and recirculating absorbers; and hydrochloric gas coolers, packed-tower absorbers, and combustion chambers. **Write or call: National Carbon Co., 30 E. Forty-Second Street, New York 17, N. Y., for Catalog Section S-5008.**

●

Chemically Resistant, High and Medium-Temperature Hose and Hose Assemblies are set forth in a new 12-page brochure. Information and specifications in the bulletin have been prepared for use by all concerned with conveying such liquids, gases, or materials as concentrated and diluted acids, alkalies, and other corrosives, hot oils, and other lubricants and steam. **Write or call: Resistoflex Corp., Woodland Avenue, Roseland, N. J., for hose and hose-assemblies catalog.**

●

Grinding Wheel Speed Selector in a handy pocket size is now available. This fingertip slide-chart can determine wheel RPM and find correct wheel diameter in inches or surface speed in feet per minute as desired. A reference table on the back shows the speeds recommended for each of the standard types and shapes of grinding wheels. **Write or call: Simonds Worden White Co., 1101 Negley Place, Dayton 7, Ohio, for grinding wheel speed selector.**

●

Univac II Data Automation System features are described in new illustrated 79-page Manual U 23. A complete guide to the Univac II system the manual contains five sections: (1) description and illustration of all available equipments and their function; (2) a nontechnical guide to the binary-number system and the seven-place code of the Univac 2 system; (3) a technical description of how the central computer is organized functionally, (4) an explanation of the system's entire repertoire of instructions, and (5) illustrations of how the computer responds to special conditions. Highlighting the versatility of Univac 2 is a two-page foldout diagram of the system and its peripheral equipment. Other handy features of the manual include a chart of the 63 code combinations of the system, a simplified block diagram of the central computer, and a complete compendium of the conventions symbolic notation, and instruction codes used with the system. **Write or call: Remington Rand Univac, 315 Fourth Avenue, New York 10, N. Y., for Manual U 23.**

●

Instrument Air Dryers Bulletin 857 describes adsorptive type of automatically regenerated dryers with capacities to 125 standard cu. ft. per minute at 90° F. and 100 psig. The four-page, two-color bulletin illustrates the operation of the dryers and contains complete specifications including a sizing nomograph. **Write or call: Anders-Lykens Corp., a Div. of Milton Roy Co., 1328 E. Mermaid Lane, Philadelphia 18, Pa. for Bulletin 857.**

●

Single and Triple Stage Vapor Fractometers new gas-chromatography instruments are described in a new 24-page brochure. The triple-stage vapor fractometer makes possible for the first time the single run analysis containing a large number of components which boil over a wide range, the maker states. The instrument is designed to make three rough cuts of a total sample without the need for preseparation and to produce three

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simultaneous analyses under optimum chromatographic conditions. Flow schematics, sampling features, applications, and specifications of the new units are included. **Write or call: Perkin-Elmer Corp., Main Avenue, Norwalk, Conn., for Vapor Fractometers Brochure.**

●

Pocket-Edition Electrical Catalog provides convenient "on-the-job" electrical product information. It features the same Killark Alumalloy fittings and fixtures appearing in Condensed Catalog 57 issued earlier. The new pocket edition measures 4 by 5½ in. It illustrates styles and lists dimensions and other pertinent information found in the larger edition. **Write or call: Killark Electric Mfg. Co., Vandeventer and Easton Avenue, St. Louis 13, for pocket-edition Catalog 57.**

●

Diesel Power Unit Catalog CR-509-G displays International Harvester Co.'s line of six diesel power units with ratings from 60 to 200 hp. Diagrams, cross-sections, exploded views, and photo close-ups illuminate the features of the units. One page is devoted to horsepower ratings and dimensions of the units. A power rating is also provided on the recently-introduced 250-hp. Turbotorque UDT-1091. **Write or call: International Harvester Co., 180 North Michigan Avenue, Chicago 1, for Catalog CR-509-G.**

●

Industrial Instrument Accessories and Supplies have been compiled in a new 60-page catalog covering Foxboro instruments. Loose-leaf Catalog 500 includes specifications, part numbers, and prices for more than 250 commonly-furnished instrument parts and supplies. It is divided into five sections: mechanical, pneumatic, electric-electronic, general, and tools and service. Among the items covered are pressure-gage and flow-meter accessories, thermometer wells, bushings and flanges, air-supply regulators and filter sets, thermocouples, dew-point elements, charts, chart drives, instrument pens, and ink. **Write or call: Foxboro Co., Foxboro, Mass., for Catalog 500.**

●

Color-Code and Calibration Chart for Thermocouple and Extensions. This chart, 8½ by 11 in. and punched for three-ring binder use, is printed in two colors on heavy card stock and plastic laminated for dirt and wear resistance. Charted on one side of the card are all thermocouple and thermocouple extension-wire calibrations with corresponding ISA calibration symbols, Thermo Electric calibration symbols, and ISA color codes. On the reverse side of the card are resistance tables for standard pyrometer wires in ohms per 100 ft. at 68° F. **Write or call: Thermo Electric Co., Inc., Saddle Brook, N. J., for color-code and calibration chart.**

●

Inert-Gas Generator System is reviewed in new Bulletin I-457. This bulletin includes flow charts and costs analyses of the system. It also depicts typical installations in petrochemical plants. **Write or call: Gas Atmospheres, Inc., 20011 West Lake Road, Cleveland, for Bulletin I-457.**

●

Direct-Current Motors and Generators are described in new Catalog-Folder SP-182. It shows their general construction features with cutaway illustrations. Included are dimensions and ratings for ½ to 200-hp. motors and ¾ to 200-kw. generators along with illustrations of applications in several industries. **Write or call: Marathon Electric Mfg. Corp., Wausau, Wis., for catalog SP-182.**

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You can talk the strange language of Oil with us because we "made up" some of the words! Fifteen of our directors are directly affiliated with the oil industry. We have one of the largest Oil Credit files in the nation; OIL LOAN service that includes oil-wise Trust Dept. counsel. See R. ELMO THOMPSON, R. OTIS McCLINTOCK, RUSSELL F. HUNT, WM. W. MICHAELS, or BILL KENDALL. Remember, in Tulsa . . . in the Middle West . . . it's BOTH pleasant and profitable to . . .

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Available for immediate delivery.

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Write or call for full specification and production data to: **Steel Pipe Division.**

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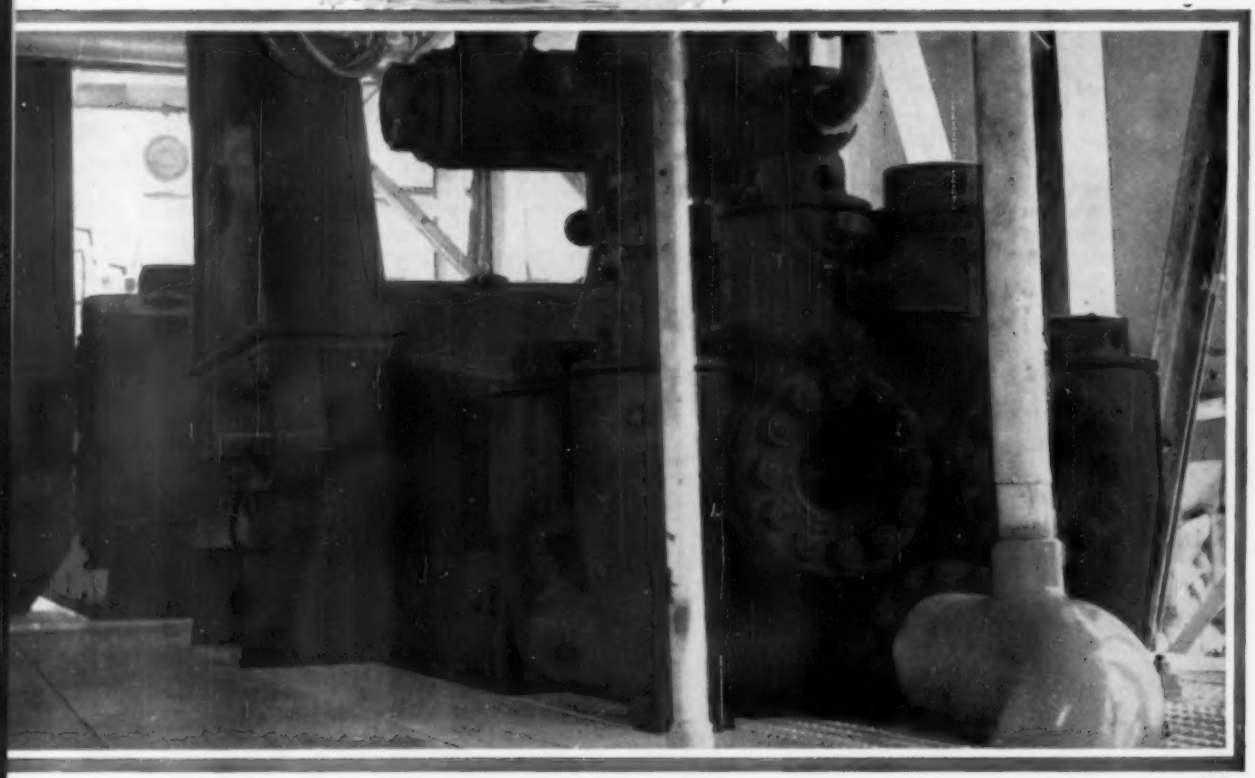

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MORE HORSEPOWER PER POUND — Provides greater volumes and pressures per pound than any other slush pump.

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Alvey Conveyor Mfg. Co. Elects W. H. Oswald . .

vice president. He will continue supervisory functions in sales and service divisions with specal emphasis on correlating and integrating all operations to make the firm's services more effective for customers.

During his 34 years with Alvey Conveyor, Oswald has served in many company departments and activities.

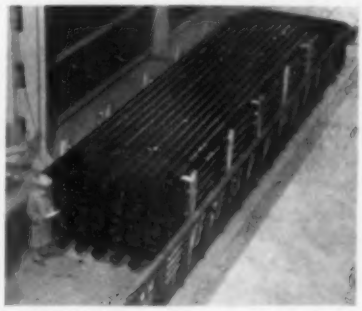
Alvey Conveyor has general offices and plant at St. Louis, Mo.

L. C. Waterman Named by Petrolite Corp. . .

L. C. WATERMAN

as sales manager of its Petreco division, succeeding I. S. Boydstun, who recently resigned. Waterman, with Petreco since 1926, has held various technical and administrative positions and, at the time of his recent appointment, was in charge of the development and commercialization of Petreco Electrofiners for petroleum distillate treatment. He recently visited Petreco clients and installations in Japan, the Philippines, Middle East and Europe.

A number of patents relating to treatment of petroleum and distillates have been issued to Waterman. He has lectured to many technical societies and is the author of several articles on the subject of his specialty.



Youngstown Ships First Seamless Casing . .

from its new Indiana Harbor Works. Normal production of this new seamless pipe works will place Youngstown Sheet & Tube Co. high among the steel companies making seamless pipe. Pipe ranging in size from 4½ to 9⅝ in. o.d. will be made.

T. R. Fullinwider Named To New Post by Mission

FULLINWIDER

Recently Mission Manufacturing Co. merged the centrifugal pump sales division with the domestic oil field sales division. Fullinwider will direct the over-all domestic sales effort.

According to Richard E. White, executive vice president and general manager, Fullinwider has been with Mission 10 years. He was domestic oil field sales manager prior to his new assignment.

Foreign Guests Attend Houston Chapter of Nomads . .

at a recent meeting of the organization. Included were: (left to right) R. E. King, Trinidad Petroleum Development Co., Trinidad, B.W.I.; P. D. Jones, Hughes Tool Co., London, England; George Corless, retired from Humble Oil & Refining, now with Institute of International Education, Houston; Jean Maillotte, Societe Petroles d'A.E.F., Port Gentil (Gabon) A.E.F.; and Klaus Wolf, Fagro, Hannover, Germany.

Newly initiated Nomads at the meeting were: J. E. Smith, Hutchison Manufacturing Co.; W. W. McBrien, Magnet Cove Barium Corp.; and Douglas B. Allison, Houston Oil Field Material Co., all of Houston.

Ralph Enloe to Manage New Bovaird Store . .

RALPH ENLOE

at Shreveport, La. This Bovaird Supply Co. store serves the drilling and producing operations of the Ark-La-Tex area. A new building has been acquired, stocked and manned to distribute a complete line of equipment to the petroleum industry.

According to W. J. Bovaird, general manager of stores, Enloe has been in the oil-field supply business 15 years.

Dresser Industries Names William E. Dobbins . .

WM. E. DOBBINS

director of its Washington office, succeeding the late Gen. Urban Niblo.

Dobbins will be responsible for representing Dresser among government agencies and with foreign purchasing delegations based in the city. He also will represent Dresser companies to private industrial firms headquartered in Washington.

Previously Dobbins was Central regional manager for Clark Bros. Co., one of the Dresser Industries, for the past 2 years. Prior to that, he was manager of the Clark Bros.-Dresser Industries Washington office and special representative in the New York City area.

J. B. Spurlock Added to Flori-Houston Sales . .

and will be headquartered in Houston. He will assist Paul D. Broussard in serving New Mexico, Texas, Louisiana, South Carolina, Mississippi, southern Arkansas, Alabama, Georgia and Florida.

Spurlock has had 30 years of experience in fabrication engineering and sales, ranging from shop work to sales administration.

Flori-Houston was formed by the merging of Flori Pipe Co., St. Louis, and Houston Pipe & Steel, Inc., and is a subsidiary of Sparton Corp., Jackson, Mich.

Sales Assignments Made by Mission Manufacturing Co.

F. HEBERT

Francis Hebert has been appointed special sales representative, valve division, for the South Louisiana district with headquarters in Lafayette, La., according to T. R. Fullinwider, domestic sales manager. Formerly, Hebert was field sales representative in the Southwest Texas district with offices in Corpus Christi. Jason Curtis replaces Hebert in Corpus Christi as field sales representative.

E. D. HALLUM

R. E. HARDY

Named special sales representative in the valve division for the West Texas-New Mexico district is E. D. (Dean) Hallum. His headquarters are in Midland-Odessa. He was formerly field sales representative in the same district, officing in Odessa.

JOE WEAVER

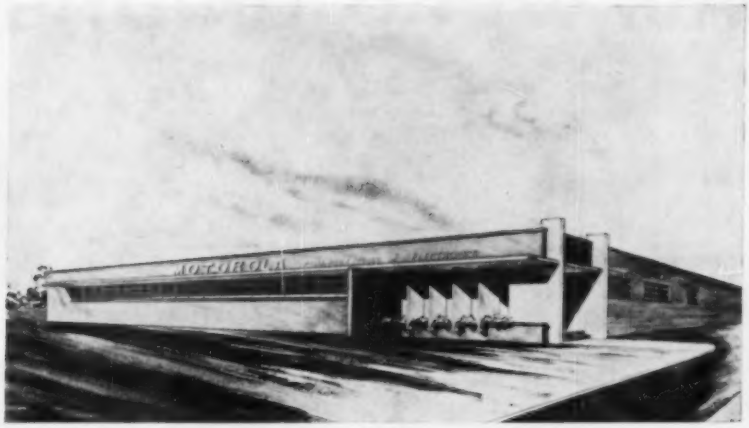
R. L. ROOTH

Replacing Hallum as field sales representative in the Odessa territory is R. E. (Jack) Hardy, formerly field sales representative in Andrews, Tex. Hardy has been replaced in Andrews by Joe Weaver. Robert L. Rooth has been named field sales representative for the Ark-La-Tex district with headquarters in Shreveport.

Carrier Corp. Units are Air-Lifted to Oil Rig . .

in the China Sea off the coast of British North Borneo.

The drilling platform has no protection from the sun and humidity, and its owners, British Malayan Petroleum Co., decided to air condition all main cabins, mess room and recreation room. To do the job in the shortest time after the room units arrived, crews from International Air Conditioning Co., Ltd., Carrier distributor, were flown daily by helicopter to the rig.



Motorola Expands Administrative Headquarters . .

in Dallas, Tex., for the ten-state southern sales area. Construction is expected to be completed by the end of the year, according to Vice President Edward L. Falls, Jr., area manager of Motorola Communications & Electronics, Inc.

The 12,000-sq.-ft. building will house a two-way radio sales office, an expanded parts depot and a microwave and industrial control sales office as well as the administrative office.

Hughes Tool Co. Adds to Research Laboratory . .

to step up its drilling research program in Houston. When this new steel and masonry addition to the block-long engineering and research laboratory is completed, working area will have been increased 50%.

Dr. Daniel J. Martin, vice president of engineering, pointed out that the highly competitive nature of the oil industry and steady increase in the cost of finding and recovering oil requires that drilling tools and techniques be constantly improved.

Four full scale drilling rigs are used to test new bit designs, bearings, materials drillability of rock formations, and new or anticipated drilling techniques.

W. C. Norris Manufacturer Creates Two Divisions . .

J. A. GETTY

in its sales organization. J. A. Getty, former district representative at Shreveport, La., has been transferred to Tulsa to head the new Central division. Under his supervision as division manager are the Kilgore, Tex., Oklahoma City and Great Bend, Kans., branches and the Tulsa city sales staff.

W. J. Whitaker has been made division manager for the North and West Texas areas, with division office in Fort Worth. The Odessa and Wichita Falls branches are under his supervision.

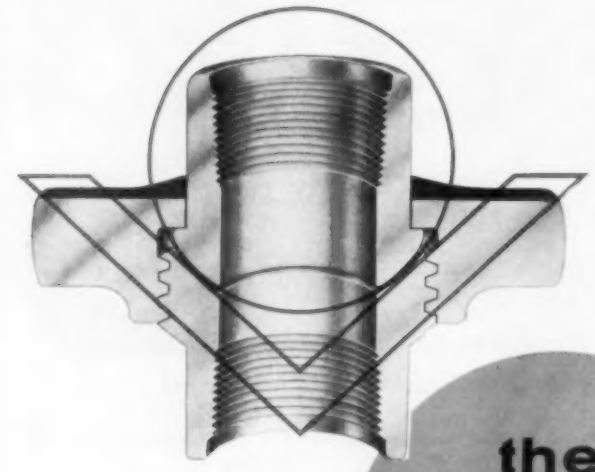
W. J. WHITAKER

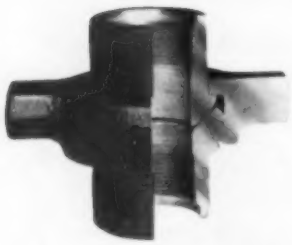
C. L. SNELLING

The Gulf Coast division continues to operate under the direction of C. L. (Les) Snelling, division manager, Houston, with Houston and Corpus Christi branches under this office.

All division managers report to

with WECO UNIONS





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● If there's any secret to the success of WECO Unions, that secret lies in the perfect seal they always produce.

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WECO Unions have great durability, as a result of stronger subs and wing nuts, heavier wall construction and sturdy Acme threads. They can "take it" on the toughest jobs, and maintain their efficiency under extremes of pressures, volumes and abrasions.

WECO Unions are available at supply stores everywhere, in sizes from 1" through 12", in pressures from 1,000 through 15,000 psi.

U. S. 57

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HOUSTON, TEXAS

WECO

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D. P. Hagaman, sales manager, Tulsa, under the general supervision of G. W. Davidson, Jr., vice president of sales.

Kaiser Steel Corp. Appoints W. E. Walton . .

W. E. WALTON

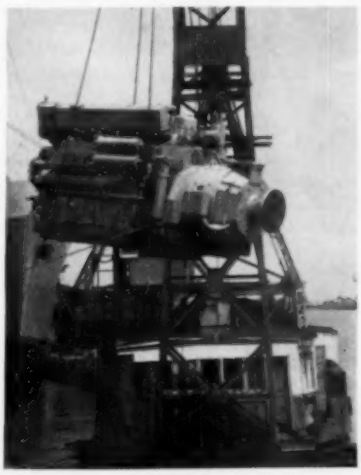
as industrial engineer in its Montebello fabricating division. He had previously served as superintendent of the underframe department and assistant plant superintendent, it has been announced by John V. Banks, production manager.

Walton was with International Derrick & Equipment Co. and Consolidated Western Steel Corp. as an estimator of fabricating costs. He joined Union Steel Co. in 1953 and served as chief estimator until Union was purchased by Kaiser Steel in 1955.

This Engine Is One Part of Diesel-Electric Power . .

designed and manufactured by Alco Products, Inc., which will permit deep drilling from a platform only 60 by 90 ft., has been installed on equipment owned by An-Son Gulf Drilling Co. at the Equitable Shipyard in New Orleans.

The advantages of the hookup, wherein the primary power—consisting of two Alco 251 Power Packages—is aft of a drilling tender, are many and important.



First, the smaller platform permits a rig setup which minimizes the number of lifts required, thus resulting in considerable savings. Secondly, the arrangement is such that the tender can be pulled away from the

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Dav-Ad 102 (alkylated phenol in toluene)

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platform leaving sufficient power on the platform so that pipe can be pulled and other lighter duties performed.

Power equipment on the tender consists of two Alco 251 engines rated at 850 hp. each, three 550-kw. d.c. generators, two 250-kw. a.c. generators and four 625-hp. d.c. motors. On the platform are the drawworks motors, main and auxiliary control cabinets, one Alco 251 engine and two 550-kw. d.c. generators.

The two mud pumps are D-1000 Models supplied by Emsco Manufacturing Co. The An-Son Gulf tender is 250 ft. long with a 50-ft. beam and a molded depth of 15 ft. 8in.

W. B. Burkman Named to Win-Well Sales Post . .

in Houston. He will serve that area as sales representative for Win-Well Manufacturing Co. of Los Angeles, manufacturer of the seven-way Multiport selector valve.

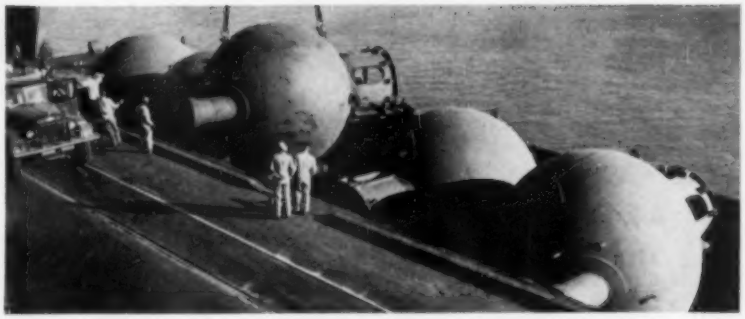
Burkman entered the oil-field supply business with Longhorn Supply Co. as a production salesman. He then served as sales and service engineer of the Gulf Coast district for Industrial Instrument Co. before starting his own company.

Halliburton 1956 Annual Report Judged Best . .

among oil well supply companies by a national judging team. Shown looking over the report are Logan D. Campbell, chairman of Halliburton Oil Well Cementing Co., and John P. Harbin, controller. An "Oscar of Industry" for the report was presented at a banquet in New York City attended by business and financial leaders from the U.S., Canada and Latin America.

The 28-page annual report, produced by Harbin, includes financial information, discussion of Halliburton services, sales products, expansion, foreign operations, research and other phases of the company. Service operations in various oil fields and scenes from the company's Duncan, Okla., headquarters facilities are shown.

Runner-up in the oil well supply category was Dresser Industries, Inc. Third place was given to National Supply Co.



Wyatt Spherical Reactors Loaded for Shipment . .

through the Inland Waterway System from Houston to Baton Rouge, La. These vessels, each 17 ft. 6 in. in diameter, were fabricated in Wyatt Metal & Boiler Works' Houston shops from 1⅞-in. plate and hauled by truck to dockside, where they were loaded in a hopper-type barge. This single barge cargo weighed more than 500,000 lb.

Ass't. Division Managers Named by Tretolite . .

for western Canada and Midland, Tex. James W. Hakeman, formerly senior corrosion engineer at Shreveport, La.,

J. W. HAKEMAN

J. H. BURRELL

has been named assistant to the Rocky Mountain division manager, L. C. Dessert, Jr. Hakeman, headquartered at Edmonton, Alta., will be over western Canada operations.

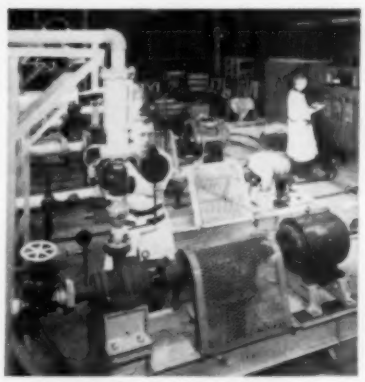
James H. Burrell, Jr., formerly senior field testing engineer for Tretolite Co., has been named assistant to John Hampton, manager of the West Central division. Since joining the company in 1938, Burrell has worked closely, both in the field and laboratory, in the testing and development of new compounds. He was continue to headquarter in Midland.

Clary Printers Available For Fast Delivery . .

as the result of the company's assembly-line production. Off-the-shelf delivery is possible for parallel entry numerical data printers for computers, data-reduction systems, weighing applications, laboratory instrumentation, production testing and process control logging systems.

Clary Corp. has standardized three read-out models with five decades of input capacity, eight decades and eleven decades, respectively, which will handle 85 per cent of data printing needs. These standard machines are available with a choice of 100 special dials, punctuation and zero suppression logic.

According to William R. Beall, sales manager for Clary's electronics division, the company will continue to build special machines, but he emphasized that orders for one of the stock models will result in savings in cost and delivery time, as well as minimize service problems.



Oil Well Supply Division Begins New Pump Line . .

at its Wilson-Snyder Works. Centrifugal pumps are tested for efficiency and performance before shipment to the customer. Charles H. Stewart, plant manager, pointed out that the up-to-date equipment in this plant is designed to machine, assemble, test and ship centrifugal pumps in one continuous operation, thus assuring closer tolerances and specifications of these pumps.

Housed in a new 140-ft. building, the facilities include recording and metering equipment, balancing machines and special calibrated motors to test volume and water pressure. Water for testing four centrifugal pumps simultaneously is stored in a 400,000-gal. reservoir.

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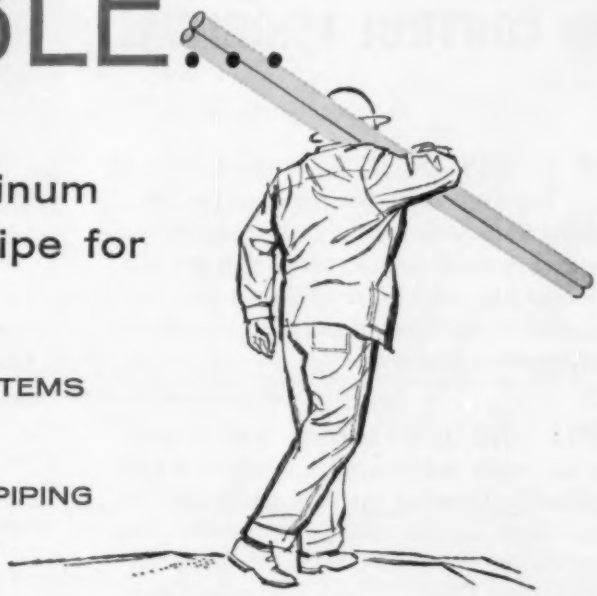

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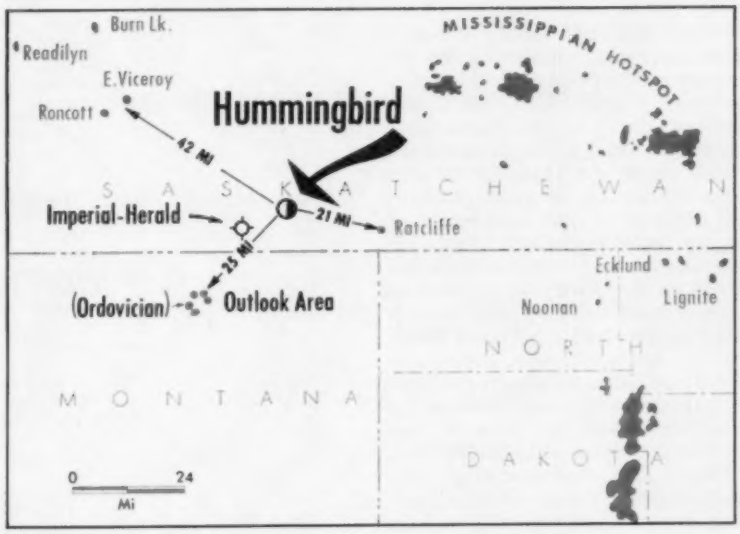
Ordovician Oil May Leap Border

By Frank J. Gardner
Exploration Editor

THE ORDOVICIAN, prolific producer of oil in the United States, has always been conspicuously missing in the reservoir listings of western Canada. The main reason is, of course, that it simply isn't there as far as Alberta is concerned. Alberta has consistently held the exploration spotlight since 1947, while Saskatchewan flitted in and out of the scene, playing a minor role. But with the discovery of the myriad Mississippian fields of southeastern Saskatchewan in 1955, 1956, and 1957, the center of attention shifted. Unlike Alberta, Saskatchewan was known to be underlain, at least in its southern half, by important thicknesses of Ordovician rocks. Here too, however, little attention was paid to their potential oil prospects, as nearly every drilling operation headed for the Mississippian, period.



SHOWINGS OF OIL in Ordovician rocks have been announced by Imperial Oil at its Hummingbird 6-13-2-19, southeastern Saskatchewan. If successful, the wildcat will give western Canada its first Ordovician production.

Outlook growth . . . Then, in January 1957, Amerada Petroleum Corp. discovered Outlook field in Sheridan County, Montana, only 10 miles south of the Canadian border. Production came from the Silurian, but Ordovician tests had been encouraging. At that time, this column commented: "This flush Silurian strike so close to the Canadian border . . . should perk up Canadian interest . . . Now, perhaps, operators throughout the northern reaches of the Williston basin will want to take a look at deeper prospects."

With the discovery of Ordovician oil at Amerada 1 Loucks, southwest of Outlook, and a more recent strike in the Devonian at 1 Patchin nearby, the entire Outlook region begins to make its impact felt. And Canadians have not ignored the challenge.

Last week, Imperial Oil, Ltd., announced the first crude-oil recovery from Ordovician rocks in western Canada. Its Hummingbird 6-13-2-19, drilling in Section 13-2n-19w2, near Gladmer, conducted four drill-stem tests over 97 ft. of hole; the top two of these, covering 47 ft. of Ordovician section at 9,848-75 ft. and 9,875-95 ft., recovered 240 ft. and 765 ft. of oil respectively.

And a Canadian debut . . . Now these are hardly what you'll call "discovery" quality tests, considering the depths from which they came. But they might well signal the advent of a new deep pre-Mississippian drilling campaign throughout Saskatchewan's share of the Williston depression. If the Hummingbird makes a well, it will be the Ordovician debut in western Canada; if it lays an egg, it will have made exploration history regardless. Imperial is drilling ahead below 10,000 ft. at the test, and may possibly carry it to the Cambrian. Exact horizon within Ordovician was not revealed, but Saskatchewan counts three formations in the section—the Winnipeg (lowermost), Red River, and Stony Mountain.

Earlier, this year, Imperial had drilled its 1 Herald as an Ordovician test and met with failure. The Herald lies 11 miles southwest of the Hummingbird in Section 31-1n-20w2 (see map).

May cause new thinking . . . The Ordovician is widespread in the south half of Saskatchewan and southwestern Manitoba; it outcrops along the Precambrian shield, but disappears to the north and northwest both in outcrop and subsurface section. The maximum thickness is about 1,000 ft. near the Canadian-United States border. Other Ordovician outcrops are known on the north shore of Great Slave Lake (Northwest Territories) and in the Canadian Rockies, but the formations are missing from the Alberta section. In Saskatchewan, subsurface Ordovician sections have been cut in the vicinity of the new Hummingbird indicator, and in the Unity area of western Saskatchewan near the Alberta border; other wells, only 35 to 40 miles west of the latter area in Alberta, have failed to pick it up.

The Outlook discoveries have jarred Montana oil finders into new lines of discovery thinking. And if the Hummingbird is a commercial well from Ordovician, we can look for similar changes in Saskatchewan and Manitoba.

Despite a decline in North America . . .

Seismic Activity Hits All-Time High

By Homer G. Patrick
Humble Oil & Refining Co.

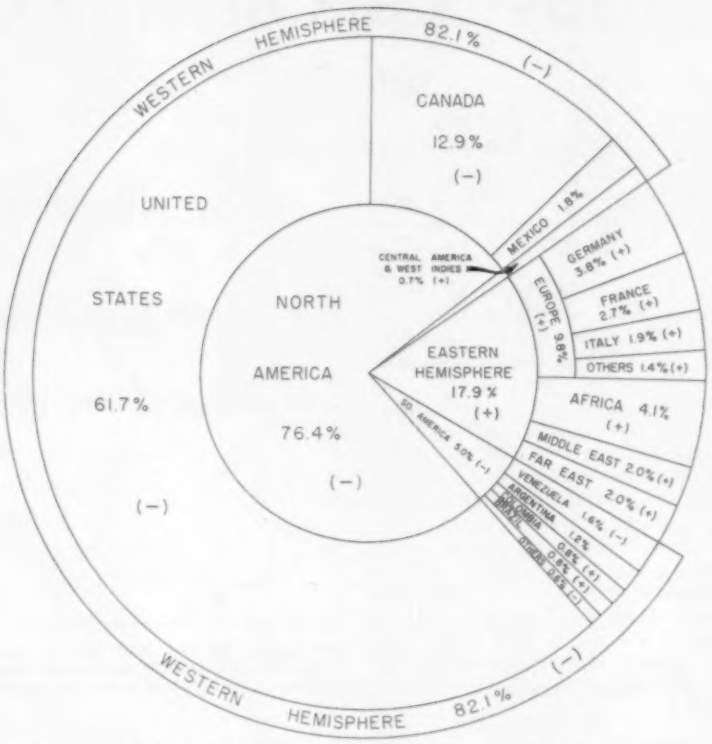
A NEW RECORD HIGH in worldwide geophysical activity by the petroleum industry was reached in 1956. Increased activity during the second half of the year was more than enough to offset the slight downward trend which was indicated at midyear. An average of 1,136 geophysical crews of all types were employed during the year, while in 1955, the previous record year, the average was 1,119 crews. Geophysics explorations were reduced below the 1955 level in the major areas of the Western Hemisphere. In the Eastern Hemisphere significant increases occurred in spite of political disturbances which caused interference with the work in parts of North Africa and the Middle East.

World-wide distribution of geophysical activities by area and by method, and rate comparisons with statistics for 1955 are shown in Table 1. Exploration by the seismic method showed a slight increase, 0.6 per cent, in 1956 as compared to the previous year. Gravity work increased 8.4 per cent and magnetic work declined 8.2 per cent.

Explorations by other methods, mainly electrical, declined 12.0 per cent and accounted for a very small portion of the total effort. In the United States declines were reported in the use of all geophysical methods. The total effort in the United States was down 4.6 per cent in 1956; explorations in Canada declined 5.4 per cent; and activity in the entire Western Hemisphere was down 3.7 per cent.

Fig. 1 shows the world distribution of seismograph prospecting during 1956; Fig. 2 shows the seismic activity distribution in the United States. The percentage figures in the divisions and subdivisions of the chart represent the per cent of the world's total seismic work. The (+) and (−) signs in this chart, as well as in the charts to follow, indicate increases or decreases in relative concentration of activity in 1956 as compared to the year 1955. The Western Hemisphere with 82.1 per cent of the world's total seismic work and particularly North America, accounting for 76.4 per cent of the total effort, continues to dominate the chart. Although its percentage participation in the global effort has been decreasing the past few years due to increased activity in other parts of the world, the United States still accounts for the major portion of the seismic exploration work. Use of the seismograph in the Eastern Hemisphere increased from 14.5 per cent of the total world effort in 1955 to 17.9 per cent in 1956.

The decline in use of the gravity method in the Western Hemisphere, coupled with stepped-up use of the method in the major areas of the Eastern Hemisphere, reduced the Western Hemisphere's participation in the world's total gravity effort from 69.7



WORLD-WIDE GEOPHYSICAL ACTIVITY reached an all-time high in 1956, although seismic activity declined in the Western Hemisphere. Plus sign (+) means a gain in 1956 over the preceding year, 1955; minus sign (−) a loss. Fig. 1.

TABLE 1—CREW-MONTHS OF GEOPHYSICAL EXPLORATION FOR PETROLEUM

	United States			Canada			W. Hemisphere			E. Hemisphere			World		
	1955	1956	Per cent change	1955	1956	Per cent change	1955	1956	Per cent change	1955	1956	Per cent change	1955	1956	Per cent change
Seismic	7,090	6,813	— 3.9	1,496	1,423	— 4.9	9,395	9,062	— 3.5	1,589	1,983	24.8	10,984	11,045	0.6
Gravity	1,074	998	— 7.1	103	88	—14.6	1,431	1,369	— 4.3	621	855	37.7	2,052	2,224	8.4
Magnetic	76	45	—40.8	....	1	....	146	127	—13.0	173	166	— 4.0	319	293	— 8.2
Other	....	1	....	....	....	....	15	18	20.0	60	48	—20.0	75	66	—12.0
Total	8,240	7,857	— 4.6	1,599	1,512	— 5.4	10,987	10,576	— 3.7	2,443	3,052	25.0	13,430	13,628	1.5

per cent in 1955 to 61.7 per cent in 1956. The decrease in gravity exploration work in the Western Hemisphere occurred wholly within the United States and Canada. Actually, the decline measured in crew-months was small. Significant percentage increases in gravity exploration occurred in Africa, the Middle East, and the Far East.

Eastern Hemisphere, Europe . . . Germany, France, and Italy, following the pattern of 1955, were the scenes of the greatest concentration of geophysical effort in Europe during 1956. The three countries combined accounted for more than 80 per cent of the total European effort. In Germany and France there were substantial increases in seismic explorations. The increasing activity in Italy noted during the first 6 months of 1956 was reversed during the second half of the year. Total geophysical operations in Italy during the entire year were about equal to those in 1955. Other countries where some geophysical work was reported are: Austria, Greece, Netherlands, Portugal, Spain, Turkey (European), and United Kingdom.

Crews of contract geophysical companies did 83 per cent of the seismic work and 90 per cent of the gravity work in Europe during 1956. All other geophysics exploration work reported for the year was done by contractors.

Africa . . . Geophysical activity increased substantially on the continent of Africa during 1956. Noteworthy increases in seismic work occurred in French Sahara and Libya. Gravity work was also stepped up in Libya. French Africa, where much of the increased activity occurred, accounted for 54.8 per cent of all geophysics exploratory work in Africa during the year. Reduced activity took place in Egypt following political disturbances in that area. Other African countries in which geophysical work was conducted are: Angola, Belgian Congo, British Somaliland, East Africa, Somalia, Nigeria, and Madagascar.

Geophysical contractors did 92 per cent of the seismic work, 95 per cent of the gravity work, and 94 per cent of the total geophysics exploration in Africa during 1956.

Middle East . . . Increased activity in geophysics explorations in the countries of the Middle East was reported during 1956. Total geophysical work of all types amounted to 475 crew-months, while in 1955 the total was 319 crew-months. Middle East

TABLE 2—GEOPHYSICAL CREW-MONTHS IN EUROPE—1956

	Seismic		Gravity		Magnetic	Others	
	Co.	Cont.	Co.	Cont.	Cont	Cont.	Total
Austria	12			3	2		17
France	...	295	...	24	1	15	335
Germany	80	328	...	60	20	6	494
Greece	...	24	...	12	12	...	48
Italy and Sicily	90	120	14	24	...	...	248
Netherlands	...	24	...	...	...	...	24
Portugal	...	24	...	9	...	...	33
Spain	...	56	...	9	...	...	65
Turkey (European)	...	24	...	14	5	...	39
United Kingdom	...	22	4	...	...	...	26
	182	913	18	155	40	21	1,339
Total	1,095		173		40	21	1,339

TABLE 3—GEOPHYSICAL CREW-MONTHS IN AFRICA—1956

	Seismic		Gravity		Magnetic	Others	
	Co.	Cont.	Co.	Cont.	Cont.	Cont.	Total
Angola	...	24	...	...	...	...	24
Belgian Congo	...	12	...	...	...	...	12
Somaliland	...	12	...	15	9	...	36
East Africa	12	...	12	12	...	...	36
Egypt	...	21	...	9	...	...	30
Fr. Equatorial Africa	...	82	...	43	16	...	141
Fr. North Africa	...	44	...	20	11	...	75
Fr. Sahara	...	123	...	55	22	21	221
Fr. Africa (total)	...	(249)	...	(118)	(49)	(21)	(437)
Nigeria	24	26	...	...	...	...	50
Somalia	...	24	...	...	...	...	24
Madagascar	...	27	...	9	...	...	36
Libya	...	24	...	68	20	...	112
	36	419	12	231	78	21	797
Total	455		243		78	21	797

TWO KEY AREAS, the Rocky Mountains and Louisiana, had an increase in seismic activity during 1956 over the preceding year. Plus signs (+) indicate a gain over the preceding year, minus signs (−) a loss. Fig. 2.

seismic operations increased from 123 crew-months in 1955 to 200 crew-months in 1956. Gravity work was also stepped up in the area with 227 crew-months in 1956 compared to 118 crew-months the previous year. The greatest concentration of effort occurred in Iraq, Saudi Arabia, Turkey, and the Persian Gulf. Most of the exploration work reported in Israel during the year was done in the first 6 months as operations were curtailed during the last half of the year. Other areas in which some geophysical activity was reported are as follows: Dhofar, Iran, Jordan, Kamaran (Red Sea), Kuwait, Quatar (offshore), and Syria.

Contract crews did 93 per cent of all geophysical work in the Middle East during 1956.

TABLE 4—GEOPHYSICAL CREW-MONTHS IN MIDDLE EAST—1956

	Seismic		Gravity		Magnetic		
	Co.	Cont.	Co.	Cont.	Co.	Cont.	Total
Dhofar	...	12	...	3	...	3	18
Israel	...	13	...	17	...	...	30
Iran	...	6	...	...	...	...	6
Iraq	...	55	...	36	...	...	91
Jordan	...	9	...	8	...	...	17
Kuwait	12	...	...	...	...	...	12
Saudi Arabia	...	48	...	24	...	12	84
Turkey (Asian)	...	20	9	65	1	32	127
Quatar (offshore)	...	...	6	...	...	...	6
Persian Gulf	...	20	...	38	...	...	58
Kamaran (Red Sea)	...	...	4	...	...	...	4
Aden	...	...	...	12	...	...	12
Syria	...	5	...	5	...	...	10
Total	12	188	19	208	1	47	475
	200		227		48		475

TABLE 5—GEOPHYSICAL CREW-MONTHS IN FAR EAST—1956

	Seismic		Gravity		Others	
	Co.	Cont.	Co.	Cont.	Cont.	Total
Australia	...	36	...	48	...	84
Netherlands New Guinea	...	24	36	...	...	60
India	...	36	...	27	...	63
Indonesia	...	24	...	12	...	36
New Zealand (and other islands)	...	12	...	4	...	16
Pakistan	...	42	...	48	...	90
Papua	24	...	12	...	...	36
Japan	...	32	...	18	6	56
Philippines	...	...	...	7	...	7
New Caledonia	...	3	...	...	...	3
Total	24	209	48	164	6	451
	233		212		6	451

Reports concerning magnetic work in the Far East appear to be incomplete, but one survey was reported in Australia. This survey consisting of 6,600 line-miles is not shown in Table 5.

Approximately 84 per cent of all geophysical work in the Far East was done by contractors.

Far East . . . Reports at midyear indicated that geophysical activities in the Far East were declining. The indicated downward trend was, no doubt, due to incomplete information at that time. Actually, geophysical activity in the area increased in 1956 as compared to 1955. A total of 451 crew-months' geophysical work of all types was reported in 1956. The 1955 total was 358 crew-months. Notable increases occurred in India and Pakistan. A considerable amount of work was carried out in Australia, Netherlands New Guinea, and Japan during the year. Other areas in which petroleum explorations were reported are: Indonesia, New Zealand and other islands, Papua, Philippines, and New Caledonia.

Western Hemisphere—South America

Geophysics exploration for petroleum continued high in the countries of South America during the year 1956, the level of activity being about the same as in 1955. The greatest concentration of effort was in Venezuela where 175 crew-months' seismic work and 35 crew-months' gravity work were reported. Argentina ranked second with 132 crew-months' seismic work and 36 crew-months' gravity work. Brazil with 90 crew-months' seismic work and 64 crew-months' gravity work was third, and Colombia was fourth with 87 crew-months' seismic work and 36 crew-months' gravity work.

Other countries in which geophysical operations were conducted are: Bolivia, Chile, Ecuador, Peru, and Uruguay. A significant number of magnetic surveys, both airborne and ground, were reported in Argentina, Bolivia, Brazil, Colombia, Ecuador, Peru, and Venezuela. A limited number of airborne scintillometer surveys were reported in Brazil and Venezuela.

Contract geophysical companies conducted 48 per cent of the seismic work, 33 per cent of the gravity work, and 41 per cent of the total geophysics operations in South America during 1956.

Central Ameria and West Indies . . . Very little geophysical activity was reported in the countries of Central America during 1956. An average of five seismic crews were in operation in Cuba during the year. A small amount of gravity work was also done in Cuba. Seismic surveys amounting to a total of 17 crew-months were carried out in Jamaica, in Trinidad, and in the Bahamas. All of the work reported was done by contracting companies.

Mexico . . . Explorations by geophysical methods were carried out by the petroleum industry in Mexico during 1956 at approximately the same rate as in 1955. Total operations for the year consisted of 200-crew-months' seismic work and 60 crew-months' gravity work. Crews of contracting companies did 78 per cent of the seismic work and 60 per cent of the gravity work, the remainder having been done by company-owned crews.

Canada . . . Fig. 3 shows the monthly variations in seismograph and gravimeter crew-months in Canada during the past 10 years. As in 1954 and

TABLE 6—GEOPHYSICAL CREW-MONTHS IN SOUTH AMERICA—1956

	Seismic		Gravity		Magnetic		Others	
	Co.	Cont.	Co.	Cont.	Co.	Cont.	Cont.	Total
Argentina	132	...	36	...	36	...	...	204
Boliva	...	12	12	8	9	...	...	41
Brazil	...	90	26	38	8	...	7	169
Chile	24	12	11	...	...	...	...	47
Co'ombia	42	45	26	10	16	...	...	139
Ecuador	...	6	...	...	...	1	...	7
Peru	...	...	1	9	...	2	...	12
Venezuela	81	94	29	6	9	...	6	225
Uruguay	...	...	4	...	...	...	...	4
Total	279	259	145	71	78	3	13	848
	538		216		81		13	848

By Glenn Taliaferro
Johnston Testers

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FIVE Important Points of D. S. T. Pressure Charts

The science of reservoir engineering is putting greater demand on the field engineer for understanding and interpretative knowledge of Drill Stem Test-Pressure Charts. Technical reservoir information can be enhanced by utilizing drill stem test data.

Realizing there is a need for proper evaluation of such data, Johnston Testers is complying by furnishing to the industry a pressure chart combining both "expanded" time and "expanded" pressure. Figures A and B illustrate the same chart, Figure A having the advantage of "expanded" time and "expanded" pressure to aid in the interpretation. By placing Figure A on a *reduced time* scale and removing the *extra inches* of deflection Figure B is produced.

Although Figure A presents a rather complicated appearance, it is simplified by realizing that

1. The chart progresses from right to left and that
2. When a pressure line reaches the left extremity of the chart it will reappear AT THE SAME PRESSURE READING ON THE RIGHT SIDE.

Points of interest on Figure A

1. Initial hydrostatic mud pressure.
2. Initial flowing pressure.
3. Final flowing pressure.
4. Final shut-in pressure.
5. Final hydrostatic mud pressure.

Reading from right to left, the pressure chart indicates the build-up hydrostatic pressure as the testing assembly is lowered in the hole. Upon reaching bottom the initial hydrostatic head of the mud column is recorded in pounds per square inch as indicated at point "1".

With the testing assembly on bottom, weight is applied and the packer is expanded isolating the desired test zone.

After the packer expands, the test tool opens exposing the test zone to the conditions in the drill pipe. This allows the pressure to drop from the initial hydrostatic mud pressure at point "1" to the initial flowing pressure at point "2" and with this decrease of pressure on the test interval, the fluid in the formation is permitted to flow into the well bore.

As the fluid flows from the formation through the perforated anchor and into the drill pipe, the pressure recorders accurately record the increase of pressure from the initial flow pressure at point "2" to the final flow pressure at point "3".

Any changes in pressure during the flow period will be recorded whether they are caused by tool manipulations or formation characteristics and will be easily identified on the flow curve. Examples of these pressure changes during the flowing period could be changing chokes at the surface, partial or complete plugging during the test, operating the equalizing valve to unplug the test tool.

After the well has been flowing for the desired length of time, the shut-in valve in the testing assembly is closed by rotating the pipe to the right. The small volume in the tester assembly from the shut-in valve to the bottom of the hole allows a rapid build-up toward the formation or reservoir pressure and the final shut-in pressure is recorded at point "4".

After the shut-in period is completed the equalizing ports are opened, allowing the mud to flow below the packer, facilitating easy removal of the packer from the packer seat. As the mud equalizes below the packer, the pressure increases to the final hydrostatic mud pressure at point "5" and as the tester is removed from the hole the chart shows the decrease in pressure and returns to the base line as the test tool reaches the surface.

All the pressures measured and recorded are due to the "actions" of various fluids encountered or controlled by the Tester. Mechanical operations, such as sudden changes in running speed, jarring, and so on, will record as vertical lines (pressure) very short time intervals. These lines will not confuse the actual test pressures as they are readily recognized as forces other than those caused by the formation.

For more comprehensive interpretative data write Johnston Testers for the booklet entitled "The Interpretation of Drill Stem Test Data."

FIGURE A

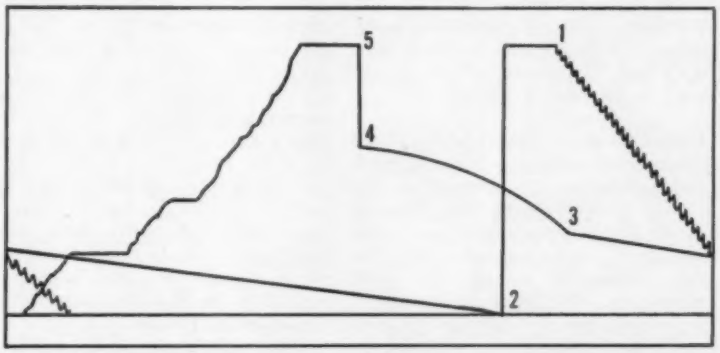
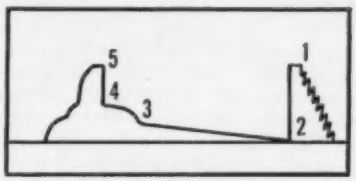


FIGURE B



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Manager of Chart Dept.
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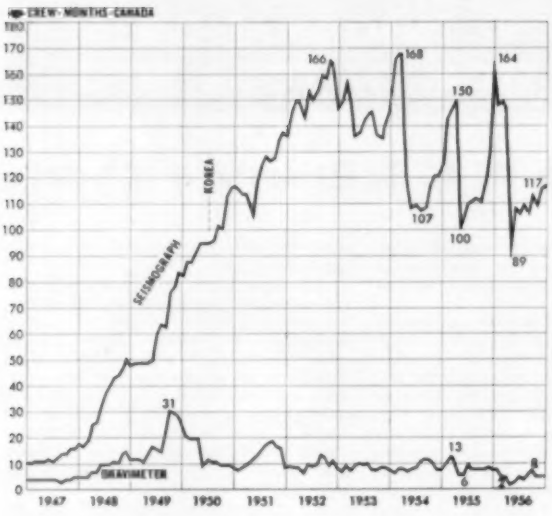


OVER-ALL GEOPHYSICAL ACTIVITY in the United States declined slightly during the year. However, the majority of the world's seismic effort is still concentrated in the U. S. Fig. 3.

CANADIAN geophysical activity, too, declined slightly during 1956. The effect of climate is clearly shown by the rapid seasonal changes in seismic activity. Fig. 4.

1955, a sharp decline in seismic explorations occurred in the early part of 1956. The number of crews in operation decreased from 164 at the end of 1955 to 89 in April, 1956, a low point in seismic activity since the spring of 1950. With increases occurring during the following months, 117 seismic crews were in operation at the year's end. The average number of seismic crews in operation in Canada during 1956 was 119 compared to an average of 124 crews in 1955 and 128 crews in 1954. An average of eight gravity crews were engaged in exploration in Canada during the year, the average in 1955 being 8.5 crews.

Approximately 25,000 flight-miles of aeromagnetic work not shown in the Table 7 was done in the western provinces of Canada during the year. This is estimated to be approximately 10 crew-months work and coverage of about 20,000 sq. miles. As in past years the major portion of the geophysical activity in Canada in 1956 was in the western provinces. Some gravity work (27 crew-months) and a very limited amount of magnetic work was reported in the provinces of Ontario, Quebec, Prince Edward Island, and the Maritimes in eastern Canada. Alberta continues to lead in geophysical activity with a total of 978 crew-months' seismic work and 52 crew-months' gravity work during the year. Saskatchewan, with 230 crew-months' seismic work and 3 crew-months' gravity work, ranked second, and British Columbia with 182 crew-months' seismic work ranked third. The remainder of the geophysical exploration work in the western provinces of Canada consisted of 33 crew-months' seismic work and 3 crew-months' gravity work in Northwest Territories and Manitoba. Contract geophysical companies did 78 per cent of the seismic work and 93 per cent of the gravity work in Canada in 1956.

TABLE 7—GEOPHYSICAL CREW-MONTHS IN CANADA—1956

	Seismic		Gravity		Magnetic	
	Co.	Cont.	Co.	Cont.	Cont.	Total
Alberta	250	728	6	46	....	1,030
Saskatchewan	54	176	....	3	....	233
Manitoba	3	13	....	1	....	17
British Columbia	11	171	....	3	....	185
N.W. Territories	....	17	....	2	....	19
Eastern Canada	....	....	....	27	1	28
Total	318	1,105	6	82	1	1,512
	1,423		88		1	1,512

United States . . . Shown in Fig. 4 are the monthly variations in seismograph and gravimeter crew-months in the United States since the year 1944. As shown by the graphs there was some curtailment in both seismic and gravity prospecting during the early months of 1956. Much of the loss in seismic activity was regained by mid-year, but further decreases during the fall months lowered the total number of seismic crews in operation at the end of the year to 525, the lowest level reached since 1951. An average of 568 seismic crews operated in the United States during 1956, compared to the 1955 average of 591 crews, a reduction in energy of 3.9 per cent.

The decline in gravity operations during the early months of the year was partially offset by gains during the fall months. Total gravity work in the United States, however, was 7.1 per cent less in 1956 than in 1955. The average number of gravity crews in operation during 1956 was 83 compared to an average of 90 crews the previous year.

The geographic distribution of seismograph prospecting in the United States during 1956 is shown in Fig. 2. There were gains, as shown by increased percentages of the total U.S. activity, in the Rocky Mountain region, the southeastern states, and in California and Louisiana. Decreases in percentage of total activity occurred in the Mid-Continent area and in the State of Texas.

Increased interest on the part of the petroleum industry in the Four Corners area, the common corner of the states of Colorado, Utah, New Mexico, and Arizona, brought an influx of seismic crews to that area during the year. This accounts for the significant gain in the Rocky Mountain region in spite of decreased activity in Wyoming, Montana, North Dakota, and other states of the

TABLE 8—GEOPHYSICAL CREW-MONTHS IN U.S.A.—1956

	Seismic		Gravity		Magnetic		Others	
	Co.	Cont.	Co.	Cont.	Co.	Cont.	Co.	Total
Texas	994	1,115	106	243	12	....	....	2,470
Louisiana	557	1,028	63	82	....	....	....	1,730
New Mexico	305	364	73	78	12	....	....	832
Nevada	6	5	10	20	....	....	....	41
California	80	94	1	27	6	....	....	208
Wyoming	217	191	6	30	....	....	....	444
Colorado	103	136	5	53	....	....	1	298
Montana	145	196	30	36	....	5	....	412
Oregon	....	....	13	....	....	....	....	13
Utah	89	90	7	46	....	....	....	232
Oklahoma	131	205	....	....	10	....	....	346
North Dakota	23	42	....	4	....	....	....	69
Mississippi	160	210	15	4	....	....	....	389
Kansas	42	74	....	11	....	....	....	127
Others	96	115	11	24	....	....	....	246
	2,948	3,865	340	658	40	5	1	7,857
Total	6,813		998		45		1	7,857

region. Seismic work continued to increase throughout the year in Mississippi while little activity was reported in the other southeastern states.

Activity continued on the decline in Oklahoma and Kansas where the major portion of the Mid-Continent seismic work was concentrated. Some seismic work was done during the summer months in Alaska. An accurate accounting of the number of crew-months of Alaskan work is not available, but it is known to be small. Contract companies did approximately 57 per cent of the U.S. seismic work in 1956, 60 per cent in 1955.

Due to stepped-up activity in the states of New Mexico, Colorado, Montana, and Utah, the Rocky Mountain area showed a large increase in gravity explorations in 1956. The Mid-Continent area showed a slight increase, but this area accounts for a very small part of the total U.S. gravity effort. All other major areas showed decreased gravity activity. Decreased activity was reported in both Texas and Louisiana. Gravity exploration work in the two states combined amounted to 50 per cent of the U.S. total in 1956, compared to 54.6 per cent in 1955 and 62.5 per cent in 1954. Contract crews did 66 per cent of the total U.S. gravity work in 1956 compared to 61 per cent done by contractors in 1955.

Seismic exploration in the offshore waters of Texas and Louisiana declined by 23.2 per cent compared to 1955 while gravity activity increased by 1.2 per cent.

Activity in seismic work in the Gulf of Mexico began to decline following cancellation of a proposed sale of offshore leases in May. Gravity work was continued, however, and reached a record high for gulf waters of 118 crew-months in 1956. In the Louisiana portion of the offshore area exploration crews did 155 crew-months' seismic work and 80 crew-months' gravity work in 1956.

The corresponding figures for the year 1955 were 322 crew-months' seismic work and 91 crew-months' gravity work. In the Texas waters, total seismic work in 1956 amounted to 47 crew-months, while in 1955 a total of 70 crew-months was reported. Exploration by means of the gravity meter increased from 14.5 crew-months in 1955 to 38 crew-months in 1956.

Note: This is an abridged version of a report by the committee on geophysical activity of the Society of Exploration Geophysicists, of which Homer G. Patrick is chairman. The complete report will appear in SEG's official publication, Geophysics.

AAPG Distinguished Lecturer Predicts . . .

Oil Is Destined for Even Greater Future Growth

By Kenneth E. Hill

Vice President, Chase Manhattan Bank, New York

VARIOUS authoritative estimates indicate United States population may rise from 168 million in 1956 to 197 million in 1966. This growth plus a rising standard of living and other trends points to an even greater expansion of over-all economic activity.

Detailed study of the energy requirements associated with the population and economic growth foreseen indicates the nation will consume about 61 quadrillion B.t.u. in 1966. That is 45 per cent more than the 42 quadrillion used in 1956. Petroleum is expected to supply about half the over-all energy needs. In doing so, demand for oil will grow at an average rate of 5 per cent per annum and reach a level of 14.3 million barrels a day in 1966.

Being at a much earlier stage of development, oil demand in the free foreign areas seems likely to expand more rapidly than in the United States. Supporting this view is the unavailability of natural gas and the difficulty of expanding solid fuel supplies in most free foreign areas. For the next decade we think demand abroad will grow about 7.7 per cent per annum and will be averaging 14.2 million barrels a day in 1966. Combined demand for the free world will exhibit a growth of 6.2 per cent a year and will total 28.5 million barrels daily in 1966.

There is little doubt that crude-oil reserves in the free world are ample in respect to anticipated demand

REMAINING ITINERARY OF KENNETH E. HILL, AAPG DISTINGUISHED LECTURER

DECEMBER 2
Alberta Society of Petroleum Geologists, Calgary.

DECEMBER 3
Rocky Mountain Association of Geologists, Denver.

DECEMBER 4
Intermountain Association of Petroleum Geologists, Salt Lake City.

DECEMBER 5
Department of Geology, Montana State University, Missoula.

DECEMBER 6
Wyoming Geological Society, Casper.

DECEMBER 9
Liberal Geological Society, Liberal, Kans.

DECEMBER 10
Panhandle Geological Society, Amarillo, Tex.

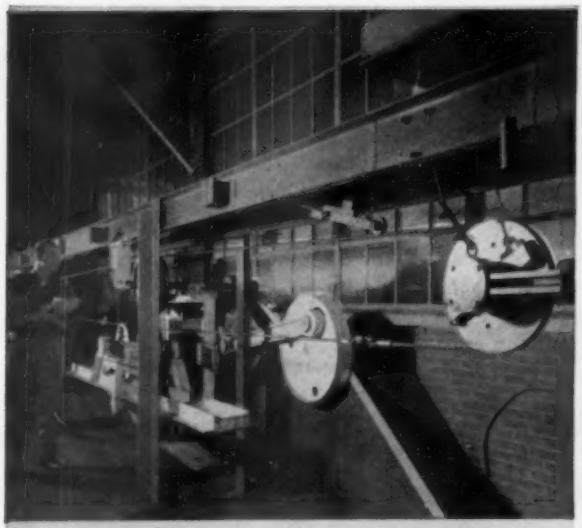
DECEMBER 10
North Texas Geological Society, Wichita Falls, Tex.

DECEMBER 11
Ardmore Geological Society, Ardmore, Okla.

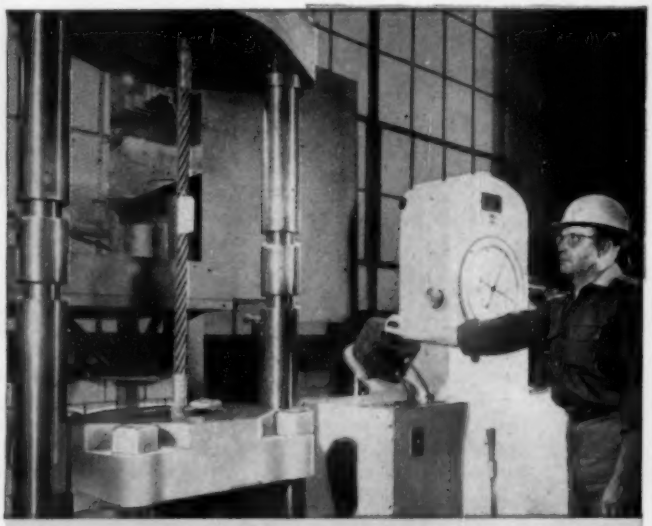
DECEMBER 12
Oklahoma City Geological Society, Oklahoma City.

DECEMBER 13
Illinois Geological Society, Mount Vernon.

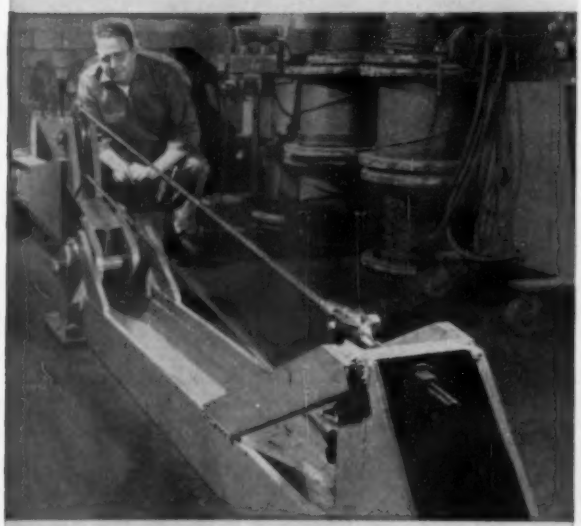
Why J&L wire rope service life



Fatigue machine. This 6 x 25 I.P.S. fiber core rope is being subjected to a continuous fatigue test to determine the number of reversed bends before breakage.



Cross-section tension test. This 1¼" 6 x 41 I.P.S.-RL fiber core rope was tested to 140,000 lbs. tensile load. Catalog requirement for same rope is only 123,000.



Vibration fatigue test subjects this boom pendant assembly to repeated shock loading. The 2,500 ft. lb. load provides action simulating actual field conditions.

Tension test of individual wires shows pounds of tensile load withstood before breaking. Every coil of wire used in J&L wire rope is thoroughly tested before acceptance.

salesmen can talk with confidence

To users and buyers of wire rope, safety and long rope life are all-important considerations. When you specify J&L, you can be confident you are buying wire rope that will stand up to the job for which it is made.

Every strand of J&L wire, every finished wire rope, is subjected to exacting tests to determine maximum factors of strength, flexibility, abrasion and corrosion resistance. This quality control is a most important operation in the production of J&L wire rope. Shown here are some of the tests that enable your J&L wire rope salesman to talk about quality with confidence.

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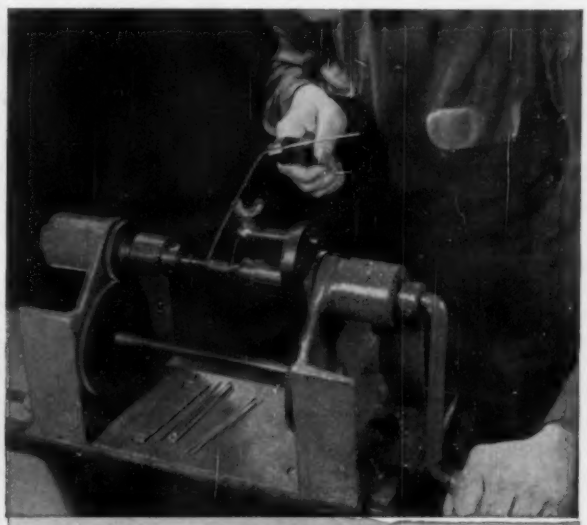
Torsion machine tests ductility by twisting wire. This 8" length of .081 wire took 41 revolutions before snapping. Federal standards require only 26 revolutions.



Wrap test. Galvanized wire is wound eight times around a mandrel of its own diameter and then unwrapped, proving ductility of wire and the bond of the coating.

(Protective screens removed during photography.)

growth. But these reserves are unevenly distributed relative to areas of greatest consumption.

The United States accounts for 57 per cent of world demand but has only 15 per cent of reserves. This nation has only a small reserve producing capacity and further growth in production is dependent on the rate of discovery. The domestic industry has found an average of 3.1 billion barrels a year in the postwar decade, but with production rapidly climbing, the reserve-production ratio has declined. We must find 1.5 bbl. for each barrel produced to provide an adequate inventory of reserves for growing demand. But for the past 5 years we have failed in this task.

To increase production, as we have forecast, from 7.2 million barrels a day in 1956 to 9.5 million in 1966, the industry must discover an average of 3.6 billion barrels per annum. That is 15 per cent greater than the postwar rate. Unless reserves of this magnitude are developed as a result of a greatly expanded drilling program—estimated to total 735,000 wells in the next decade—United States production will not reach the levels predicted. To accomplish this, sufficient funds must be provided from capital formation under a favorable tax and regulatory climate.

Because reserves are large relative to production, free foreign output is capable of expansion in most areas at a rate much faster than in the United States. The Middle East, Venezuela, and Canada will contribute most to the additional production. But all areas of the world are expected to show gains as a result of the enormous growth in world-wide exploratory efforts.

NOTE: This is a summary of a talk entitled "Future Growth and Financial Requirements of the World Petroleum Industry" that the author is currently presenting to various geological societies throughout the United States and Canada.

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EXPLORATION HIGHLIGHTS

APPALACHIAN

OHIO

Semi-Wildcat Makes Clinton Producer

A semi-wildcat 1 mile north of production in north-central Monroe Township, Coshocton County, Patton and Atha 1 Glenn Williams, Section 3, gaged 150 bbl. and 2,500,000 cu. ft. in 24 hours after fracture. Clinton sand was found at 3,475-3,548 ft. with 20 bbl. and 225,000 cu. ft. natural.

Extension Finaled West Of Marne Pool

A 3,200-ft. west extension of Marne pool in Madison Township, Licking County, was completed by Pennoco Oil & Gas Co. on 1 Harris Bros., Lot 8, 3rd Qr. Clinton sand at 2,617-58 ft. made 75 bbl. in a 24-hour test after fracture.

Extension Area Opened In Holmes County

Two producers in Killbuck Township, Holmes County, opened up extension areas for production. Oxford Oil Co. 1 (4) Wm. Bucey, Section 6, gaged 150 bbl. and 3,000,000 cu. ft. after fracturing Clinton at 3,461-3,500 ft. Tedrow et al 1 James Carpenter, Section 15, made 75 bbl. and 400,000 cu. ft. after fracturing Clinton at 3,237-64 ft.

PENNSYLVANIA

Two Wildcats Listed As Failures in Southwest

In Ligonier Township, Westmoreland County, Southwest Pennsylvania, Snee & Eberly 1 Sarah W. Essler wildcat, elevation 2,767 ft., was a failure resulting in salt water. The chert was 7,929 ft., water 8,000 ft. Total depth 8,009 ft.

● Felmont Oil Corp. 1 Penna. Game Comm., Tract 42 is dry at a total depth of 8,050 ft. No deep formations were recorded to this depth.

OKLAHOMA

SOUTH

More Pay Tested at Love County Discovery

More Oil Creek-Ordovician sand pay was tested at Pasotex Petroleum Co.'s 1 Brannan wildcat in NW NE SE 30-7s-3e, south of Enville field in Love County, extreme southern Oklahoma.

This well was originally drilled to 10,624 ft. and abandoned. Later deepening took it to the Oil Creek at 14,108 ft. Perforations at 13,948-14,110 ft. flowed distillate at the daily rate of 215 bbl. plus 4,000 M.c.f. of gas on ⅛-in. choke. Other tests were made at 14,110-20 ft.

NORTHWEST

More Gas Gaged at Ellis County Strike

Pan American Petroleum Corp. 1 Tune, Ellis County discovery in C NW SE 35-24n-23w, flowed open 16,500 M.c.f. of gas per day on 1½-in. opening from Morrow sand at 7,855, 7,862, and 7,876 ft. The daily flow was calculated on basis of a 6,050 M.c.f. per day flow. Location of this wildcat is 15 miles east of Gatesby field near the Woodward County line.

PANHANDLE

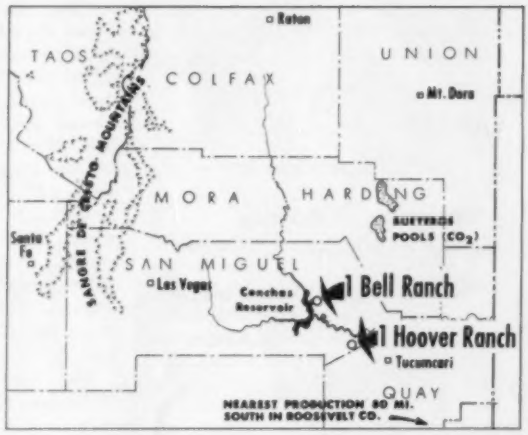
Morrow Flow Reported At Hardesty Strike

Carter Oil Co. 1 Jolliffe Unit, C NW SE 27-3n-12eCM, Northwest Hardesty field in Texas County, flowed 13,400 M.c.f. per day on ¾-in. choke from upper Morrow-Pennsylvanian sand at 6,336-56 ft. The well also flowed 25 bbl. of condensate in 6 hours. Another test earlier at 6,422-34 ft. had an open flow of 21,000 M.c.f. daily.

SOUTH-CENTRAL

Bromide Pay Proved at New McClain Discovery

Gulf Oil Corp. 1 Beard is a new first Bromide-Ordovician discovery in McClain County. The well, southwest of Payne, flowed 37 bbl. of oil per hour plus 1,800 M.c.f. of gas per day on test at 10,712-32 ft. From perforations at 10,739-10,814 ft. it made 66 bbl. hourly and 1,120 M.c.f. of gas per day.



Two rank wildcats have been staked on the southwest flank of Sierra Grande uplift in San Miguel County of northeastern New Mexico. Contracts are for 7,000 ft., or basement rock.

Two Deep Tests Located In Rank Wildcat Territory

Northeastern New Mexico gained two petroleum prospectors in San Miguel County, 80 miles north of nearest Roosevelt County production.

The two wildcats are being drilled by Miami Petroleum Co. Abilene, Tex. Locations are northwest of Tucumcari, and appear to be on the southwest flank of the Sierra Grande uplift, a north-south trending feature extending from southern Quay County, northward into Colorado.

There is little geological information on this area but maps show it to be studded with dry holes. Most of these have been shallow, while the two new prospectors are scheduled to 7,000 ft., or to the Precambrian granite.

The tests are designated as 1 Hoover Ranch, NW NW 14-12n-28e, 13 miles northwest of Tucumcari. Henson Drilling Co. has contract.

No. 1 Bell Ranch is in the NW SE 34-15n-26e, 32 miles northwest of Tucumcari. Sojourner Drilling Co. has contract.

Maimi Petroleum will earn a 10,000-acre lease by drilling the 1 Hoover Ranch, and may select up to three more well sites on the 216,000-acre ranch, each of which will earn another 10,000-acre block. The company was said to have a straight commercial lease on all of the 113,000-acre Bell Ranch.

Location of 1 Hoover Ranch is near the crest of the Johnson dome, described as a large oval structure occupying most of the township, and 1 Bell Ranch location is near the crest of Bell arch.

Reference: Phil D. Helmig, Petroleum Possibilities of Northeast New Mexico, see The Oil and Gas Journal, Jan. 11, 1954. . . . "The Sierra Grande uplift was an old positive area in existence during Pennsylvanian time and consequently, most of the tests drilled along the flank and on the uplift proper have gone out of Permian directly into thin Pennsylvanian clastics and/or into granite or basement. The Pierre shale sand lenses are mostly exposed as in the Dakota and most of the Cretaceous in the area.

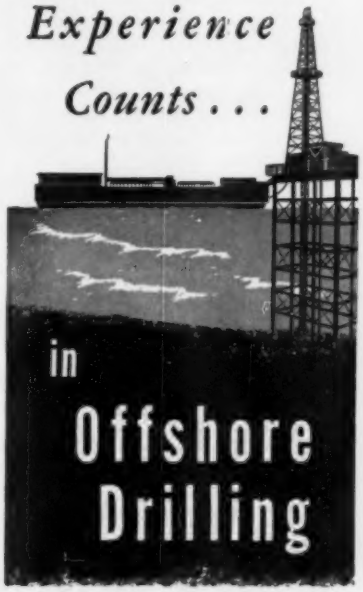
"The object beds for petroleum accumulation would be the Dakota where buried, and the Permian formations, where they are not a trashy nature, along the uplift which is not conducive to commercial accumulations of petroleum."

ROCKY MOUNTAINS

WYOMING

New Gas Field Opened In Fremont County

The California Co. 1 Spratt, SE SE 5-38n-90w, Fremont County, is a new Upper Cretaceous discovery for Wyoming. The well was completed from two zones for a combined flow of 8,275 M.c.f. per day. Flow from 8,934-48 ft. was 3,400 M.c.f. daily. Flow from 8,793-8,809 ft. was 4,875



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M.c.f. per day. Gages were taken on a 40/64-in. choke.

This is a rank wildcat discovery, being located 24½ miles south of production at Black Mountain and 30 miles northwest of Muskrat field. There has been little deep drilling in this area. The new field is located in the extreme northern part of the Wind River basin.

Flow Reported at New Sweetwater Discovery

A new gas discovery in Sweetwater County flowed 5,692 M.c.f. of gas per day from Lakota at 3,996-4,016 ft. It is Caulkins Oil Co. 8-8 Federal in C SW SW 8-15n-104w, 3 miles south of production at the South Baxter Basin field. Flow was gaged on a ¾-in. choke.

CANADA

ALBERTA

Edith Lake Discovery Makes Big Flow

Home Oil Co., Ltd.'s third indicated oil success in the Virginia Hills-Swan Hills area of northwestern Alberta has been completed with an initial restricted flow rate of nearly 1,400 bbl. per day. This well, which developed a total thickness of 315 ft. in the Slave Point formation, including one interval of 146 ft. of pay zone with scattered porosity over the balance of the section, made its production test from only 35 ft. of that zone. Development of this virtually untested region of western Canada has been slowed down somewhat by muskeg conditions which prevail during the spring and summer months, however, with operating conditions improving the company expects to commence full-scale winter development and exploration activities shortly.

The production rate mentioned above was recovered from the Home et al-Regent 11-19-67-10 Edith Lake, located on LSD 11, 19-67-10w5. It lies 20 miles northeast of the Home-Union-H.B. 9-20 Virginia Hills venture, which was the initial discovery well in this region, and 5 miles southwest of the Home et al-Regent 8-11 Swan Hills well that also discovered oil in the Beaverhill Lake-Slave Point structure. That latter well, has not been completed as yet but those operations are also included in the firm's winter program.

Actual initial production recovered from the well was 1,392 bbl. per day and it came from perforations in the production casing below the 8,290 ft. level. Choke sizes ranged from 20/64-in. to 24/64-in. and gas oil ratio measured 560 cu. ft. per barrel. Gravity of the oil measured 39.5°.

This well is the fourth test well on the 182,000 acres of reservation rights in which the team of Home, Alminex Ltd., United Oils, Ltd. and Geoil, is earning interests. As was stated before, three of the wells have indicated successful completion while the other was noncommercial and consequently abandoned.

Bow Island Gas Tapped at Brooks

The Canadian Montana Gas Co. has discovered gas in the Bow Island (Viking) formation at a well in the Brooks area of southern Alberta, 95 miles southeast of Calgary's city limits. Production casing is now being run on the venture to further evaluate the showings recovered from that formation during drill-stem test operations. Two tests were carried out on the hole, one of which covered the first Bow Island sand and the other took in the second and third sand sectors. Gas flow rate during the initial evaluation reached a maximum of 627,000 cu. ft. daily; while the next

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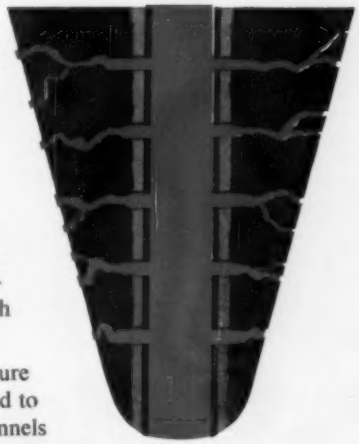

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recovered a maximum of 521,000 cu. ft. per day.

This venture, C.M.G. 11-16-19-14 Brooks, was drilled on LSD 11, 16-19-14w4. It is 2½ miles west of the Cal-Standard Brooks 36-14-19-14 abandonment and 2 miles east of the York-Pathfinder A-1 Brooks dry hole.

SASKATCHEWAN

First Ordovician Oil Possible at Hummingbird

A well in southern Saskatchewan drilled by Imperial Oil, Ltd., this week set a spark which quite easily could mean the start of a deep-drilling project in the province, when, for the first time in the history of the industry in that area, good volumes of crude were recovered from the Ordovician horizon, around the 10,000-ft. level. That formation as well as the Silurian has been proved oil productive in the Outlook area of Montana, 25 miles southwest of this new strike, but, although showings have been made before from this formation, Saskatchewan's operations have been futile. Four drill-stem tests, covering a total of 97-ft. of hole were run, but the initial two which covered 47 ft., were the only ones to give up crude oil showings. Commercial prospects of the well are still an unknown factor and it is not known whether further tests will be carried out in this regard or not as crew is currently making further hole below the discovery horizon.

This venture is known as Imperial 6-13-2-19 Hummingbird, and is being drilled on LSD 6, 13-2-19w2. Another Ordovician test 1-31 Herald, also drilled by Imperial, lying 11 miles west-southwest of the new strike, encountered some showings earlier this spring but was finally abandoned.

Initial test in the horizon gave up 2,500 ft. of oil flecked water cushion along with 240 ft. of oil (32.9°) while the second recovered 2,520 ft. of oil flecked water cushion, 765 ft. of oil containing 10 per cent salt water and 540 ft. of salt water.

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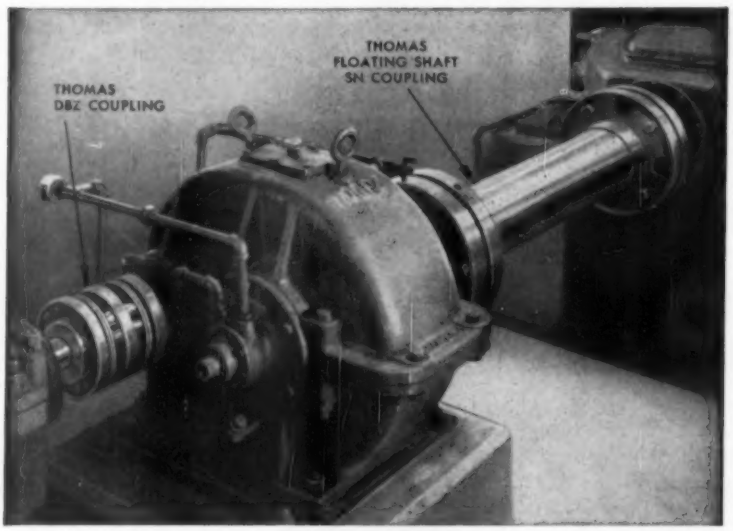

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TEXAS

PANHANDLE

Dalhart Basin Gas Discovery Indicated

The first exploratory news to come out of the Dalhart basin in the far northwest corner of the Texas Panhandle in some time is Rip C. Underwood's 1 Peeler wildcat in northeastern Dallam County, an indicated gas discovery.

The well, 4 miles southeast of Kerrick, kicked off and flowed 17,300 M.c.f. of gas per day from perforations at 3,496, 3,486, 3,446, 3,434, and 3,404 ft. There were six shots per foot in this zone. Operator is now cleaning the well for a potential test. Location is Section 49, Block 1-T, T&NO Survey, 5½ miles east of Kerrick field, one of the basin's first producers.

GULF COAST

Alta Loma Well Breaks Producing Depth Record

A newly completed well in the Alta Loma area of Galveston County has become the deepest producer in District 3 (southeastern Texas).

It is Phillips Petroleum Co.'s 1 O'Daniel, which flowed at the rate of 7,000,000 cu. ft. of gas per day from Frio sand, perforated in 5 intervals from 14,656 to 14,747 ft.

Bottom of the producing intervals is 1,679 ft. deeper than that of the district's previous deepest producer. That well was Pan American Petroleum Corp.'s 1 Sanborn, discovery well in the Sanborn area, Matagorda County. It was completed in 1954 as

a gas-condensate well with bottom of pay at 13,068 ft.

Phillips' well, which opens a new pay at Alta Loma, was drilled to 15,500 ft., lacking 500 ft. of equalling the field's and county's drilling depth record of 16,000 ft.

Shut-in pressure of the well registered 9,120 psi., top, and 11,592 psi., bottom-hole. Gas flow carried 52°-gravity condensate in the ratio of 15,500 cu. ft. per barrel. Perforated intervals are 14,656-73 ft., 14,680-90 ft., 14,692-98 ft., 14,706-18 ft., and 14,740-47 ft.

LOUISIANA

NORTH

Tuscaloosa Discovery Completed in Tensas

Tensas Parish, in the northeastern part of the state, has a new Tuscaloosa field.

Its discovery is by Jett Drilling Co., Inc., at 1-H Fisher, in 4-12n-11e, about 2 miles northeast of Saranac.

The well is rated good for 144 bbl. of 43.8°-gravity oil per day, flowing through 7/64-in. choke. Its pay is perforated at 8,393-8,403 ft. Total depth is 8,501 ft.

SOUTH

Second Bancker Well Opens Two Gas Zones

The second well in the recently opened Bancker field, in eastern Vermilion Parish, is being completed as a gas-condensate producer from two deep zones, the upper perforated at 10,571-74 ft., and the lower at 11,845-49 ft.

The field's discovery well was oil-productive from perforated interval at 10,617-23 ft. This well, completed last August, was drilled by Trice Production Co. and Christie, Mitchell & Mitchell. The new gas-condensate well is Union Oil & Gas Corp.'s 1 Dedrick-Dehart. Its location is a little more than a mile east of the Trice discovery.

The area is 3 to 4 miles southwest of the large multiple-pay Erath field.

ILLINOIS BASIN

INDIANA

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ILLINOIS

Jasper County Wildcat Is McClosky Strike

In Jasper County J. W. Rudy has completed the 1 M. E. Kessler in S½ SE NE 11-6n-10e, 5 miles east of Newton. The well pumped 90 bbl. of oil per day from McClosky at 2,697-2,703 ft. and 2,706-16 ft.

ARKANSAS

New Discovery Revives Old Lewisville Area

New production has been opened in the old Lewisville area, a mile north of Lewisville, in Lafayette Parish, in the southwestern part of the state.

The discovery is in a sand at the Upper-Lower Cretacious contact. Pay is perforated at 3,030½-33½ ft. with hole bottomed at 3,105 ft.

Operators are John C. Robbin, Jr., and Jackson Oil Co., who have completed their discovery well, 1 Pennington Estate, with a flow of 56 bbl. of 29.6°-gravity oil per day through ¼-in. choke. Flowing pressure is 180 psi., and gas-oil ratio 297 cu. ft. per barrel.

The new area will be known as Old Town field. It is at the southwest edge of the old producing area.

CALIFORNIA

Union Gives Stenderup Another Big Well

Union Oil Co. of California scored again with a big producer in its

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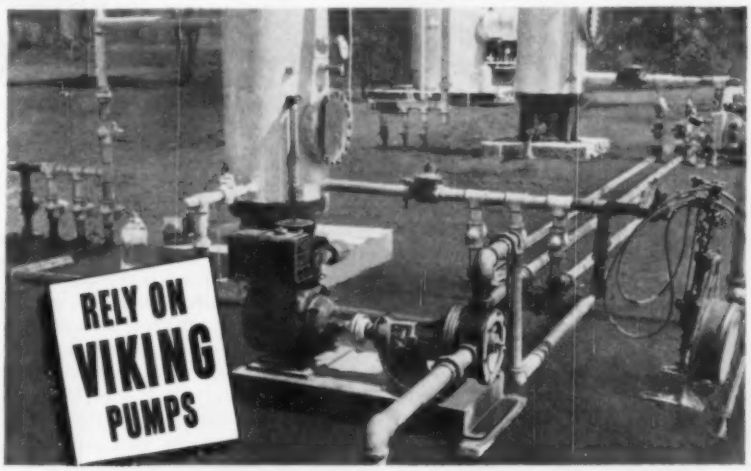

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recovered a maximum of 521,000 cu. ft. per day.

This venture, C.M.G. 11-16-19-14 Brooks, was drilled on LSD 11, 16-19-14w4. It is 2½ miles west of the Cal-Standard Brooks 36-14-19-14 abandonment and 2 miles east of the York-Pathfinder A-1 Brooks dry hole.

SASKATCHEWAN

First Ordovician Oil Possible at Hummingbird

A well in southern Saskatchewan drilled by Imperial Oil, Ltd., this week set a spark which quite easily could mean the start of a deep-drilling project in the province, when, for the first time in the history of the industry in that area, good volumes of crude were recovered from the Ordovician horizon, around the 10,000-ft. level. That formation as well as the Silurian has been proved oil productive in the Outlook area of Montana, 25 miles southwest of this new strike, but, although showings have been made before from this formation, Saskatchewan's operations have been futile. Four drill-stem tests, covering a total of 97-ft. of hole were run, but the initial two which covered 47 ft., were the only ones to give up crude oil showings. Commercial prospects of the well are still an unknown factor and it is not known whether further tests will be carried out in this regard or not as crew is currently making further hole below the discovery horizon.

This venture is known as Imperial 6-13-2-19 Hummingbird, and is being drilled on LSD 6, 13-2-19w2. Another Ordovician test 1-31 Herald, also drilled by Imperial, lying 11 miles west-southwest of the new strike, encountered some showings earlier this spring but was finally abandoned.

Initial test in the horizon gave up 2,500 ft. of oil flecked water cushion along with 240 ft. of oil (32.9°) while the second recovered 2,520 ft. of oil flecked water cushion, 765 ft. of oil containing 10 per cent salt water and 540 ft. of salt water.

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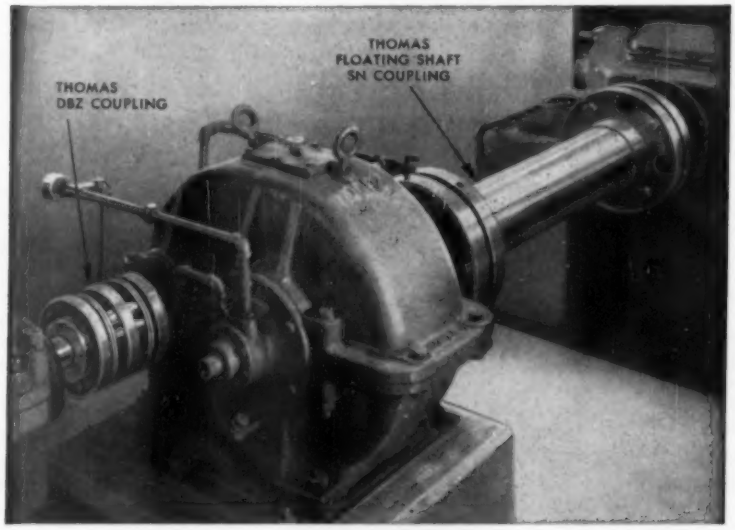

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WARREN, PENNSYLVANIA, U.S.A.

TEXAS

PANHANDLE

Dalhart Basin Gas Discovery Indicated

The first exploratory news to come out of the Dalhart basin in the far northwest corner of the Texas Panhandle in some time is Rip C. Underwood's 1 Peeler wildcat in northeastern Dallam County, an indicated gas discovery.

The well, 4 miles southeast of Kerrick, kicked off and flowed 17,300 M.c.f. of gas per day from perforations at 3,496, 3,486, 3,446, 3,434, and 3,404 ft. There were six shots per foot in this zone. Operator is now cleaning the well for a potential test. Location is Section 49, Block 1-T, T&NO Survey, 5½ miles east of Kerrick field, one of the basin's first producers.

GULF COAST

Alta Loma Well Breaks Producing Depth Record

A newly completed well in the Alta Loma area of Galveston County has become the deepest producer in District 3 (southeastern Texas).

It is Phillips Petroleum Co.'s 1 O'-Daniel, which flowed at the rate of 7,000,000 cu. ft. of gas per day from Frio sand, perforated in 5 intervals from 14,656 to 14,747 ft.

Bottom of the producing intervals is 1,679 ft. deeper than that of the district's previous deepest producer. That well was Pan American Petroleum Corp.'s 1 Sanborn, discovery well in the Sanborn area, Matagorda County. It was completed in 1954 as

a gas-condensate well with bottom of pay at 13,068 ft.

Phillips' well, which opens a new pay at Alta Loma, was drilled to 15,500 ft., lacking 500 ft. of equalling the field's and county's drilling depth record of 16,000 ft.

Shut-in pressure of the well registered 9,120 psi., top, and 11,592 psi., bottom-hole. Gas flow carried 52°-gravity condensate in the ratio of 15,500 cu. ft. per barrel. Perforated intervals are 14,656-73 ft., 14,680-90 ft., 14,692-98 ft., 14,706-18 ft., and 14,740-47 ft.

LOUISIANA

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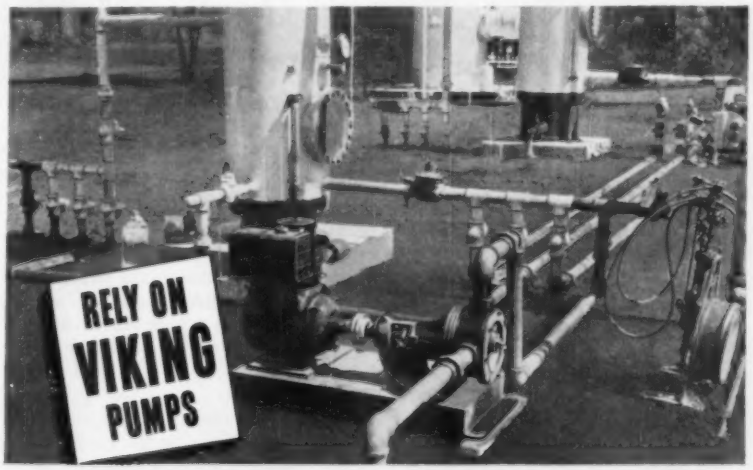

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The positive suction of Viking rotary pumps makes it possible to draw to or from several tanks. This versatility makes the pump applicable for any arrangement of tanks, treaters and separators.

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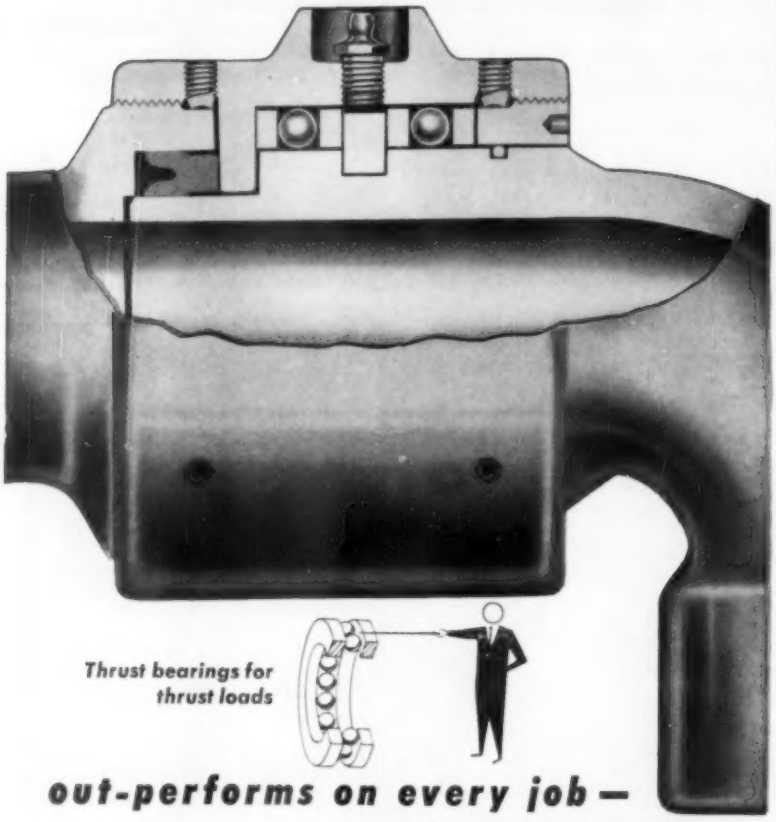

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Grooved packing for high temperatures or corrosive services.

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Stenderup pool activity. The latest completion, 46-21 Stenderup, which came in flowing 923 bbl. daily of 31.1°-gravity crude from the interval 10,195-10,283 ft. Total depth is 10,360 ft. Union has moved into the next section, 22-31s-29e for its next extension effort in the area.

The Texas Co. Misses at Oxnard

After a series of good wells on extension tests in the west side of the Oxnard field in Kern County, Texaco recently missed with a deep try about 2½ miles southwest of the field. Texaco abandoned at 10,167 ft. wildcat in 14-1n-22w, after running a formation test of an interval at 9,520-70 ft.

In other activity at Oxnard, Standard Oil Co. of California recovered gassy mud and muddy gassy oil on a formation test of the interval 6,780-7,047 ft. on an extension test in the northwest part of the field. This well is 13-2 McGrath.

Mount Poso Extended

Trico Oil & Gas Co. extended production in Mount Poso field, Kern County, more than ½-mile southeast of active production with a wildcat in NE NE 10-27s-28e. The well, 10-2 USL, was completed on the pump making 10 bbl. daily of 14.5°-gravity crude, 1.3 per cent cut, from perforations at 1,291-1,305 ft.

Saugus Discovery for Union

Union Oil Co. of California came up with what appears to be a marginal new field discovery in the Saugus area of Los Angeles County. The well, 4 NL&F, is located in NW NW 15-4n-16w, which is about 2 miles southeast of the prolific southeast area of Honor Rancho field. Union's discovery was completed in an interval at 10,077-10,539 ft. pumping only 55 barrels gross, 45 net of 29.9°-gravity crude, 21 per cent cut. Production was declining rapidly and the cut increasing.

MICHIGAN

Fifth Well Completed In Scipio Field

The fifth oil well in the Scipio field, Hillsdale County, completed for estimated 400 bbl. daily from Trenton limestone at 3,759 ft. as two other field tests apparently missed pay sections.

Newest successful completion in the southern Michigan play was C. A.

Dowell Guide to Acidizing . . .

1 DEVONIAN
Lea County, New Mexico

Vugular formation usually below 12,000 feet. Common treatment is 500 gals. Mud Acid, followed by 3000 gals. acid with Dowell wetting and emulsion control agents. Results: wells often potential from 1500 to 1800 bopd.

2 MADISON
Williams County, North Dakota

Highly fractured vugular limestone of low porosity. Permeability seldom over two millidarcys. 90 to 92 per cent soluble. Usual treatment: Acid Petrofrac® — 250 gals. fluid per foot. Results: wells often test 200 to 1000 bopd.

3 D-1
Lac St. Anne Area, Alberta, Canada

Tight dolomitic formation. Responds well to Mud Acid wash, followed by 2000 to 4000 gals. Dowell acid with agents to control silicate swelling and emulsion. Results vary but generally considered profitable by the operator.

4 ELLENBURGER
Andrews County, Texas

Usually below 13,000 feet. Often needs only 500 to 1000 gals. Mud Acid. Where further stimulation is needed, 5000 to 20,000 gals. Dowell X Acid with silicate control and anti-emulsifying agents is used to good effect.

5 McCLOSKY
Clay County, Illinois

Oolitic limestone formation, 12 to 30 feet thick at about 3000 feet. Responds well to 5000 gals. Dowell acid containing surface tension reducing agent and a non-emulsifying agent. Results: wells often produce 240 bopd after acidizing.

6 RODESSA
Cass County, East Texas

Oolitic limestone at about 6000 feet. Usual treatment: 1000 gals. Dowell acid with wetting agent. Then 2000 gals. Channeling Acid and 10,000 gals. Dowell acid with wetting agent. Results: wells often test over 700 bopd.

These are just six examples of Dowell acid treatments that are being used successfully under widely varying conditions. Whatever *your* well conditions, call Dowell for dependable, profitable stimulation treatments. Dowell Incorporated, Tulsa 1, Oklahoma.

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DOWELL has the fracturing service to help you unlock your formation

WHAT'S your formation?
Limestone, chert, dolomite, sand?
Each one's different and there are many variations within each general formation.

That's why Dowell has developed eight basic fracturing services—each for a specific purpose in stimulating well production. Also, numerous chemical additives have broadened the range of these *basic* treatments to make them even more effective in widely-varying formations.

But Dowell is not stopping here. Still better materials, techniques and equipment are being developed by Dowell's field and laboratory research groups. The Dowell organization—chemists, engineers, field personnel—is a team you can count on to help you unlock *your* formation. Dowell Incorporated, Tulsa 1, Oklahoma.

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Services for the oil industry

DOWELL

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Perry 2 Housknecht in SE NE 10-5s-3w, 1,320 ft. east of Aurora and McClure 1 Stevens "blowout well," that flowed 200 barrels per hour from equivalent depth in Trenton.

Five rigs currently are running in area, and with single exception all are from ¾ to 2 miles out from proved production.

Successful Wildcats

BRITISH COLUMBIA

Gulf States 6 Gundy Creek, 94-B-16-A-76. Triassic gas well. TD 4,467 ft.

Texaco N.F.A. 7 Nig Creek, unsurveyed B.C. TD 5,095 ft. Triassic gas well.

ALBERTA

Canadian Chieftan 10-29-34-6 Provost, LSD 10, 29-34-6w4. TD 2,800 ft. Viking gas well.

Cree et al 6-30-55-24 Cardiff, LSD 6, 30-55-24w4. TD 5,100 ft. basal quartz gas well.

Sohio Imperial 2-11-41-24 Tees, LSD 2, 11-41-24w4. TD 6,100 ft. basal quartz gas well.

Pan American Blood I.R. A-1, LSD 8, 23-6-24. TW 6,878 ft. Indicated Mississippian oil well.

Phillips C14-13-60-11 Pleasant, LSD 14, 13-60-11w5. Viking oil well. TD 4,200 ft.

Imperial 16-21-11-5 Hazelwood, LSD 16, 21-11-5w2. TD 4,128 ft. Mississippian oil well.

McAlester Gordston 2-29 NE Midway, LSD 2, 29-15-19w3. TD 3,632 ft. Shaunavon oil well.

Williamson 4-19 Wauchope, LSD 4, 19-7-33w1. TD 3,826 ft. Mission Canyon oil well.

SASKATCHEWAN

Canadian Seaboard 10-20 Fusilier, LSD 10, 20-34-27w3. Detrital oil well. TD 2,813 ft.

Mobil Oil Woodley Sinclair X2-21 Cantuar, LSD 2, 21-16-17w3. TD 7,312 ft. Souris Valey gas well.

NEBRASKA

Kimball County: Claude Wentworth Drilling Co. and Ellis Jones 1 Shaw, C NE NE 33-14n-54w. IPP 158 BOPD, "J" sand 5,994-6,000 ft. TD 6,074 ft. Opens new pool.

Banner County: McDaniel Drilling Co. 1 Brown, C NE SE 11-18n-54w. IPP 288 BOPD, "J" sand 5,387-96 ft. TD 5,428 ft. Opens new pool.

Columbine Exploration Co. 1 Burnett, C NE SE 7-18n-53w. IPP 34 BOPD, "J" sand 5,390-94 ft. TD 5,459 ft. New pool.

Pan American 1-B J. R. Cross, C SW SW 28-19n-56w. IPP 150 BOPD, "J" sand 6,162-70 ft., 6,178-82 ft. TD 6,240 ft. New pool.

NORTH DAKOTA

Stark County: Leach Oil Co. et al 1 William Kalanek, C SW NW 32-140n-96w. IPP 140 BOPD, 25° gravity, Madison 8,746-66 ft., 8,690-8,724 ft., 8,800-10 ft. TD 9,100 ft. New pool.

McKenzie County: Amerada Petroleum Corp. et al 1 Bears Den Unit, 25-149n-96w. IPF 146 BOPD, 40.1° gravity, 22 BW, Nesson-Miss. 9,530-9,605 ft. TD 9,844 ft. New pool.

NORTH LOUISIANA

Concordia Parish: Marlin Exploration, Inc., 1 Magee-Evans, 43-6n-9e (2 miles west of Warnicott). IP 96 BOPD, 9/64-in., 24.8°, TP 220 psi., perforations 3,224-25 ft. (Sparta). TD 6,813 ft. (New field—Warnicott.)

Catahoula Parish: Durbin Bond & Co. 1 Tensas Delta-Monaghan, C SW SW 32-9n-7e. IPF 165 BOPD, 43° gravity, Wilcox 4,371-73 ft. TD 5,010 ft. Opens Mean Lake pool.

Claiborne Parish: A. J. Hodges and Union Producing Co. 1 Sims "A," SWc 29-20n-5w. IP 7,850 M.c.f. of gas per day, Cotton Valley-Bodcaw 8,724-30 ft., Cotton Valley-Vaughn 8,780-95 ft. TD 9,070 ft. New pay in Bodcaw and Vaughn for Sugar Creek pool.

DeSoto Parish: John C. White 1 J. H. Joyner, NEc SE SW 28-11n-12w. IPP 7 BOPD, 15 BW, Paluxy 2,881-87 ft., 3,041-44 ft. TD 3,066 ft. Opens Pelican pool.

Union Parish: Pan American 1 James, C SW SW 8-20n-1e. IPF 230 BOPD, 57.8°, Smackover 10,354-68 ft. TD 11,-118 ft. Opens Farmerville pool.

LaSalle Parish: H. L. Hunt 1 Louisiana Delta Lumber Co. "F," SWc 12-5n-4e. IPF 110 BOPD, 45° gravity, Wilcox 5,110-14 ft. TD 6,010 ft. Opens Long Slough pool.

Nebo Oil Co. 91 fee, C NE NW 8-6n-3e. IPP 36 BOPD, 4 BW, Sparta 1,867-70 ft. TD 4,490 ft. New pay discovery in West Catahoula Lake pool.

SOUTH LOUISIANA

Cameron Parish: Gulf Oil Corp. 1 State Lease 3014, Township 13s-4w, in Grand Lake (no section). IP 78 BOPD and 1,630 M.c.f., small chokes, 44.8°, TP

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Designed for safety

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"Brother, when this thing goes dead—she really goes dead!"

5,900 psi., perforated 10,588-10,602 ft. TD 12,000 ft. (New name and southwest extension Grand Lake field.)

Livingston Parish: A. J. Bankhead 1 Evans, 49-8s-3e. IP 76 BOPD, 3/32-in., 49.5°, GOR 1,447 cu. ft. per bbl., TP 775 psi., perforations 9,642-55 ft. TD 10,086 ft. (Discovery well of Maliets Bluff field, recompleted in new pay—originally completed in August 1957 from perforations at 9,709-13 ft.)

KENTUCKY

Hopkins County: Stouder and Ashland Oil & Refining Co. 1 C. R. Stearman, 1-I-24. IPP 49 BOPD, McClosky 2,217-23 ft. Opens North St. Charles pool.

Daviess County: Indiana Farm Bureau-R. Halbert 2 Towery-Prudential Insurance Co. 11-O-26. IPP 25 BOPD, Palestine 1,360-70 ft. TD 1,370 ft. Opens St. Joe pool.

Larry Cooper et al 1 Paul Camp, 23-O-31. IP 8 BOPD, 15 BW, Waltersburg 879-88 ft. TD 1,517 ft. Oil discovery.

MONTANA

Dawson County: Shell Oil Co. 13-12-D Unit, NW SW 12-13n-55e. IPP 222 BOPD, 18 BW, 37.1° gravity, Red River 8,926-52 ft. TD 9,080 ft. Oil discovery.

LOUISIANA OFFSHORE

Vermilion Parish: Superior Oil Co. 1-A OCS 0565, Block 102, Vermilion area, Gulf of Mexico. IP 2,769 M.c.f. daily with 3.16 BOPD, 7/32-in., 45.2°, TP 2,554 psi., perforations 7,346-56 ft. TD 10,893 ft. (New offshore field and new salt dome discovery—top salt 8,366 ft.)

INDIANA

Gibson County: Bury Drilling Co. 1 Reynolds, NE SE NE 17-3s-10w. IPP 48 BOPD, 190 BW, Jackson 1,759-78 ft. TD 1,782 ft. Oil discovery.

Spencer County: Cato Enterprises 1 Varner, NE NE SE 14-6s-5w. IPP 5 BOPD, O'Hara 1,049-56 ft. TD 1,056 ft. Extension to North Grandview pool.

Felmont Oil-G. P. Ellison 1 R. P. Beren, SE NE NE 31-6s-5w. IPP 40 BOPD, Aux Vases lime 1,282-85 ft. TD 1,285 ft. Opens West Grandview pool.

Posey County: R-K Petroleum Co. 1 M. Blount et al, SE SE NW 4-7s-14w. IPP 125 BOPD, Tar Springs 2,137-42 ft. TD 2,142 ft. Extension to Welborn Consolidated pool.

SOUTHEAST NEW MEXICO

Lea County: Neville G. Penrose 1 T. G. P.C. State, 33-16s-33e, 13 miles NE Maljamar. IP 1,056 BOPD, 36-in., 42°-gravity, Pennsylvanian 11,708-22 ft. TD 11,842 ft.

UTAH

Emery County: English Oil Co.-American Petrofina 1 Government, C SE SE 4-21s-7e. IP 1,600 M.c.f. of gas per day, Ferron 920-940 ft., 954-964 ft., 1,031-41 ft. TD 1,059 ft. New pool.

Grand County: Cabeen Exploration Co. 1 Union-Government II, 2,000 M.c.f. of gas per day, Morrison 2,122-50 ft. TD 2,554 ft. Gas discovery.

San Juan County: Carter Oil Co. Bluff Bench Unit C-436, No. 4, NW NW 20-40s-22e. IP 78 BOPD, 22 BW, 37° gravity, Hermosa "A" 5,377-82 ft., 5,386-94 ft., 5,397-5,410 ft. Paradox "B", 5,476-82 ft., 5,490-96 ft., 5,518-24 ft., 5,532-39 ft., 5,545-62 ft., and Paradox "C," 5,600-22 ft. TD 5,633 ft. Oil discovery.

WYOMING

Carbon County: Pan American Petroleum Corp. 1 UPPR-Anchutz Ranch, C NE NW 3-20n-80w. IPF 534 BOPD, 51 BW, 43° gravity, Sundance 6,475-6,510 ft. TD 7,846 ft. Oil discovery.

Sublette County: Belfer, Cater, Mountain Fuel 1 Unit, C SW SW 14-27n-114w. IP 7,400 M.c.f. of gas per day, 85 BOPD, 47° gravity, first Frontier sand 6,254-6,346 ft., 6,362-82 ft., second Frontier sand 6,810-18 ft., 6,846-58 ft., 6,864-90 ft. TD 7,575 ft. Opens Dry Piney field.

ILLINOIS

Wayne County: Theodore Lindsay 1 Ernest Legg, N½ NE NE 2-1s-5e. IPP 84 BOPD, McClosky 3,078-86 ft. TD 3,099 ft. Extension to West Johnsonville pool.

Whaley Oil Corp. 1 Gallaher-Green, SE SE SW 22-2s-7e. IPP 214 BOPD, Aux Vases 3,236-50 ft. TD 3,380 ft. Extension to Aden pool.

Franklin County: Paul Mosebach 2 Mosebach-Peabody, NW NW 9-7s-3e. IPP 135 BOPD, 30 BW, Aux Vases 2,823-27 ft. TD 2,875 ft. Opens Deering City pool.

R-K Petroleum 1 Bundy Community, NW SE SE 2-7s-4e. IPP 40 BOPD, Aux Vases 3,135-41 ft. TD 3,141 ft. Extension to Southwest Akin pool.

Saline County: C. E. Brehm 1 Harris, NW NW NE 29-7s-5e. IPP 100 BOPD, Aux Vases 3,134-54 ft. TD 3,161 ft. Extension to Dale pool.

Gallatin County: George S. Engle 1 Leona Wood-Wisenbeard et al, SE SE SE 21-7s-10e. IPP 75 BOPD, 1 BW, McClesky 2,961-68 ft. TD 2,980 ft Extension to East Inman pool.

Saline County: Fitch Bros. Oil Co. 1 Ethel Abney, SW SW NW 20-8s-5e. IPP 3 BOPD, 20 BW, Aux Vases lime 2,929-32 ft. TD 3,120 ft. Opens West Hargo pool.

Marion County: Higgins & Whittinghill 1 M. A. Bruce et al, SW SW NE 34-1n-2e. IPP 110 BOPD, 20 BW, Rosiclare 2,180-97 ft., 2,195-98 ft. TD 2,201 ft. Extension to Salem Consolidated pool.

Clinton County: National Associated Petroleum Co. 1 H. J. Schlafly, NE SW NW 36-2n-3w. IPP 8 BOPD, Silurian 2,598-2,616 ft. TD 2,647 ft. Extension to South Huey pool.

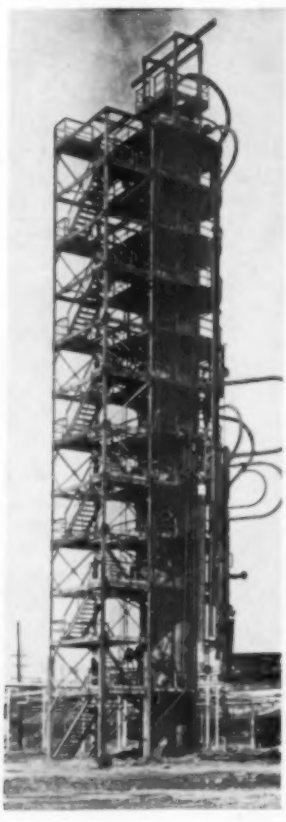
Clay County: McCollum & Kincaid 1 C. V. McKnelly, NW SE NE 10-5n-6e. IPP 3 BOPD, 50 BW, Rosiclare 2,792-99 ft. TD 2,806 ft. Extension to Sailor Springs pool.

Sangamon County: V. S. & S. Drilling Co., Inc., 1 Spicer, SE SE SE 6-15n-3w. IPP 58 BOPD, 15 BW, Hardin 1,653-59 ft. TD 1,782 ft. Opens West Roby pool.

Douglas County: J. Frank Hinkle 1 Hood, SE SE 36-15n-7e. IPP 14 BOPD, Rosiclare 1,769-75 ft. TD 1,775 ft. Opens East Chesterville pool.

MISSISSIPPI

Wayne County: Gulf Oil Corp. 1 Charles Green, 2-9n-9w. IP 233 BOPD, ¼-in., 43.5°, GOR 445 cu. ft. per bbl., TP 980 psi., perforations 8,067-69 ft. (Paluxy). TD 9,881 ft. (New pay in Eucutta field—first Lower Cretaceous production in field.)



FOR SALE

High pressure bubble tower in perfect condition

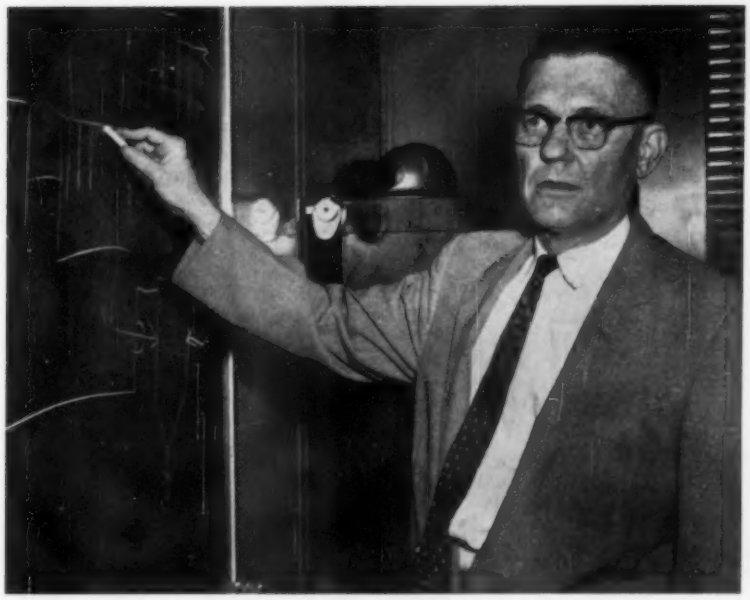
8′ ID x 95′ high from base ring to top of shell proper. Shell length is 82′6″ x 1-7/16″ thick. Skirt is 8′ OD x 12′6″ x 1″ thick. 1-7/16″ ellipsoidal heads. Bottom shell extension, 3′ ID x 5′ x 9/16″ thick. Double butt weld joints throughout. Tower lined throughout with 7/64″ 11-13% chrome U. S. S. 12 #410 stainless steel shell. Heads and shell extension fabricated from ASTM-A-70 firebox grade steel. Skirt fabricated from ASTM-A-7 plate grade steel. Tower complete with 25 bubble trays, all 12% chrome #410 S steel. Tower also c/w stairway and platforms.

Tower designed for 275 pounds per square inch, with operating temperature of 800 degrees fahrenheit. 386 pounds per square inch allowable working pressure at atmospheric temperature. Hydrostatic test pressure: 579 pounds per square inch. Shell was stress relieved after fabrication.

Shell fabricated by A. O. Smith Corporation. Stainless steel trays and caps by Fritz W. Glitsch & Sons.

Complete assembly and fabrication details, with original mill and test reports, available on request.

Call Lou Miller, Riverside 1-5055, Dallas, Texas, collect — or write P. O. Box 10387, Dallas, Texas.



Charles N. Kimberlin

Esso's Kimberlin Honored

. . . by fellow scientists. Now assistant director of Esso Laboratories, he holds 83 patents which range over the whole petroleum refining field.

WHEN CHARLES N. KIMBERLIN, JR., received the Southern Chemist Award last month he became the first petroleum scientist to be so honored.

Kimberlin, assistant director of Esso Research Laboratories, Baton Rouge, was cited for his "outstanding career in the fields of catalysis and petroleum chemistry" (OGJ, Nov. 18, p. 403). The award was presented at the Southeast regional meeting of the American Chemical Society in Durham, N. C.

The 47-year-old scientist's work in catalytic cracking has been widely credited as a big factor in building up the Allied air superiority which helped swing crucial battles of World War II. Kimberlin himself thinks appraisals of his work are "exaggerated."

If Kimberlin's right, then it must be said that his associates are almost unanimously wrong. Here are some of the things they say about him:

. . . "His contributions to the field of catalysis are immeasurable . . . He is tops in research." (This comes from Robert E. Wood, associate director of Esso Research Laboratories.)

. . . Kimberlin's contributions, "from early advances in sludge dispersants and oxidation inhibitors for lube oils to present-day petrochemicals . . . have ranged over the fields of isomerization, alkylation, industrial greases, fluid coking, and catalytic reforming." (This is from a statement by M. Foster Moose, chairman of the ACS Memphis section, who presented the award to Kimberlin.)

. . . "Early experimental work on a commercial process for upgrading crude and residual oils by fluid coking was carried out under his direction." (This is a company statement which even Kimberlin won't deny.)

. . . The official ACS citation, representing the collective acclaim of hundreds of his fellow scientists, lauded Kimberlin for "advances . . . touching nearly every phase of the petroleum industry."

Born scientist . . . Kimberlin can't explain how he got into research work. "That's just what I wanted to do," he says matter-of-factly.

"And also I happened to get a job. In 1933 that was hard to do."

He liked the first job he got after coming out of Louisiana State University with a master's degree in chemistry. It's the same job he now holds. The title has changed, of course, notably when he was promoted to assistant director 3 years ago. But, as far as Kimberlin's concerned, his job now as in 1933 is to solve old problems and discover new opportunities for the petroleum industry.

He's done his share of both during his 24 years at Baton Rouge. He has received 83 U. S. patents and "numerous" foreign ones.

Ignoring the accolades from fellow scientists, the genial Esso official insists that his associates should be given joint credit for many of his achievements. Although he is keenly interested in training young scientists and in inspiring them to greater accomplishments, there's a touch of wistfulness in his voice as he recalls the days before he became a company executive.

"I'm sorry I don't have the time for all the lab work I would like to do," he admits.

Amateur researcher . . . Not all of Kimberlin's research work is aimed at the problems of oil. In his spare time he is a devoted horticulturist.

On his farm a few miles south of Baton Rouge he has close to 50 varieties of trees. One of his pet projects, though less successful than his laboratory work, is developing citrus trees for cool climates.

It's said that he once almost achieved success in this field, too. He developed a cross-bred orange which would resist cold weather, but it turned out to be too bitter to eat.

Kimberlin's wife is the former Grace Gilmore, a Baton Rouge girl whom he married in 1937. They have a 16-year-old daughter.

Arno A. Anders, division production superintendent at Midland, Tex., for Continental Oil Co., has been named president of the 1958 Permian Basin Oil Show slated for October in Odessa. He succeeds **Roy Carter** of Kermit, Tex. New vice presidents are **Luther Reynolds,** Pan American Petroleum Corp., Andrews, Tex., and **John Hostetler,** consulting engineer, Monahans. **W. T. Edwards,** Odessa Natural Gasoline Co., Odessa, is treasurer.

James C. Saks, manager of gas supply for Trans-Canada Pipe Lines, Ltd., has been named sales manager of the company. As manager of gas supply for Trans-Canada since 1955, Saks has been active in negotiating contracts for long-term supplies of gas. A graduate of the University of Alberta and Harvard University, Saks joined Trans-Canada in 1954 as assistant to the president.

Personals

P. A. HARDMAN

P. A. Hardman, district superintendent for Service Pipe Line Co. in Topeka, Kans., has been transferred to Chanute, Kans., in the same capacity. Hardman succeeds **I. M. Barnett,** who has been transferred to Stamford, Tex., as district superintendent. **R. R. (Curley) McAnear,** formerly district superintendent at Stamford, has been named superintendent of the El Dorado, Ark., district. All three are veterans with Service Pipe Line. Hardman joined the company in 1917, Barnett, in 1925, and McAnear, in 1928.

I. M. BARNETT

R. R. McANEAR

Theodore P. Malinowski has been appointed an assistant director of product development in Atlas Powder Co.'s chemicals division. Malinowski was formerly a development manager. He has been with Atlas since 1956 and was development engineer with Monsanto Chemical Co. before that time.

Lester W. LeFavour has been appointed area production superintendent at Gulf Oil Corp.'s new Casper, Wyo., production office. **W. D. Mitchell** has been named area production superintendent in Durango, Colo. **John Heller** has been named area production foreman there.

J. M. Roe has been appointed district drilling supervisor for Pan American Petroleum Corp. in Cody, Wyo. **G. H. Lancaster,** formerly at Rangely, Colo., has been transferred to Riverton, Wyo., as field superintendent. **L. A. King,** production foreman, will head the company's Rangely area office.

Wilbur Hunt, head of lube oil operations at Esso Standard Oil Co.'s Bayonne, N. J., refinery, has been transferred to the New York manufacturing department as section head in the lubricants and specialties division. **Dick Kiddoo,** who has been on special assignment for the past few months, will succeed Hunt at Bayonne. Hunt had been head of lube operations at Bayonne since 1955. Kiddoo was head of coordination at Bayonne before his special assignment.

Philip G. Reynolds has been named assistant drilling superintendent for Rimrock Tidelands, Inc.

Robert H. Brooks, staff geophysicist for Mobil Oil of Canada in Calgary has been promoted and sent to Nigeria as geophysical representative for Mobil Exploration Nigeria, Inc., an affiliate.

Gerald W. Walker and **David A. Welch,** Pan American Petroleum Corp. geologists in Denver have been transferred to Bismarck, N. D. **Dick Davis,** Pan Am geophysicist in Billings, Mont., has also moved to the Bismarck office.

Dr. Byron M. Vanderbilt, assistant director in Esso Research & Engineering Co.'s chemicals research division, has been named senior research associate for the company. A graduate of Indiana and Purdue universities, Vanderbilt has been with Esso since 1938.

W. L. Moody, III, and **Lee F. Capshaw** have opened offices of Moody Properties, a new drilling and production company, in Corpus Christi. Capshaw is manager of the company. **Edward Brown,** geologist with Tex-Penn Oil & Gas Corp., has joined the firm.

Dr. Felix Mendoza, formerly senior petroleum engineer with Texas Petroleum Co. of Venezuela, has joined Superior Oil Co. of Venezuela as assistant manager. Mendoza is a past president of the National Petroleum Council of Colombia, and former director of the oil fiscal division of the Colombian Ministry of Mines and Petroleum.

Frederick T. Poole has been appointed assistant general counsel to the Committee for Oil Pipe Lines in Washington. Poole, a graduate of Iowa State College and the University of Colorado, was formerly with Selvage & Lee in Washington.

R. N. Creek, assistant superintendent for Union Oil Co. in Portland, Ore., has been promoted to administrative assistant in the transportation and supply department and transferred to Los Angeles.

L. J. RICHARDS

L. J. Richards, vice president and a director of Hudson's Bay Oil & Gas Co., Ltd., has been named senior vice president of the company. Richards joined Hudson's Bay in 1948. **H. W. Blauvelt,** assistant controller of Continental Oil Co., has also been elected senior vice president of Hudson's Bay. **K. H. Burgis,** treasurer and secretary of the company, has moved up to financial vice president. In the exploration division, **M. B. Morris,** assistant manager of Continental Oil Co.'s headquarters geological section in Houston, has joined Hudson's Bay as assistant manager of exploration. **R. J. Hamilton,** staff geologist with the company since 1949, has been named assistant chief geologist. Hudson's Bay Oil & Gas is owned by Continental and Hudson's Bay Co.

Gordon S. Wise, Sinclair Oil & Gas Co., has been elected president of Intermountain Association of Petroleum Geologists. Other officers are: **Clifford N. Holmes,** Phillips Petroleum Co., and **Richard A. Howe,** General Petroleum Corp., vice presidents; **Jack L. Wroble,** Continental Oil Co., secretary; and **John H. Scheufler,** Standard Oil Co. of California, treasurer.

Cecil D. Robinson, formerly vice president of Delhi-Taylor Oil Corp., has joined Gillring Oil Co. in Mission, Tex., as vice president.

A. T. Tyler, supervising engineer for Bechtel Corp. in Van Nuys, Calif., has been transferred to Canadian Bechtel, Ltd., in Calgary in the same capacity.

E. S. Morris, production superintendent for Amarillo Oil Co., has been elected a vice president. **J. A. Tipton** has moved up to succeed Morris as production superintendent.

R. Frank Nowlin, engineer in the Texas distribution division of United Gas Corp., has been promoted and placed in charge of Houston division operations. A graduate of the University of Texas, Nowlin has been with United Gas since 1940. He had been engineer in the Texas distribution division since 1953.

J. C. Wells, formerly production superintendent for **Sid W. Richardson** in El Campo, Tex., has joined **Ted O. Groebl** as production superintendent in Big Spring, Tex.

Personals

R. E. McADAMS

R. W. BOND

J. E. CLARK

C. P. BRISTOL

R. E. McAdams, exploration manager for Shell Oil Co., has been named vice president in charge of exploration for North America. **R. W. Bond,** production manager for the company, has been transferred to Tulsa as vice president in charge of the Tulsa area. Bond succeeds **C. P. Bristol,** who will transfer to Midland, Tex., as vice president in charge of the Midland area. **J. E. Clark,** vice president in Midland, moves to New York as vice president, production, succeeding Bond. The appointments take effect January 1. McAdams joined Shell in 1936. He has been exploration manager since 1955. Bond and Bristol had held their present positions since 1951.

Rollin W. Whited has been promoted to drilling superintendent for Inland Drilling Co. **W. E. Morrison** and **George Shoaff,** drillers with Inland, have been promoted to tool pushers.

K. H. Rowland, works manager for Union Carbide Chemicals Co., has been appointed vice president of production. Union Carbide Chemicals is a division of Union Carbide Corp. Rowland joined the corporation in 1934.

R. E. Baker, gasoline-plant foreman for General Petroleum Corp. in Athens, Calif., has been transferred to Santa Fe Springs, Calif., in the same capacity.

J. F. Pollock, Amoco Chemicals Corp. process engineer group leader in Brownsville, Tex., has been transferred to Joliet, Ill., as technical director for the company.

Clifford Oman, process superintendent at the Tuscola, Ill., plant of National Petro-Chemicals Corp., has been named assistant plant manager there. Oman joined National Petro-Chemicals, a subsidiary of U. S. Industrial Chemicals Co. and Panhandle Eastern Pipeline Co., in 1951. He was with Shell Oil Co. before that time.

W. Earnest Graham has resigned as vice president of Philzona Petroleum Co. in Phoenix, Ariz., to join Texas Eastern Transmission Corp. as administrative manager of the Little Big-Inch division. Graham, beginning in 1930, worked for Phillips Petroleum Co.'s sales division for 24 years, then for 2 years with Richfield Oil Corp. before joining Philzona.

George L. Hancock, Jr., has been transferred by Gulf Oil Corp. to Oklahoma City from Tulsa.

B. W. Haywood has been promoted by Gulf Oil Corp. from zone exploration manager in Jackson, Miss., to district manager in Shreveport, La.

R. E. Pierson, senior process engineer at Amoco Chemicals Corp.'s Brownsville, Tex., plant, has been transferred to Chicago as project development engineer for the company.

William W. Clawson, recently named Magnolia Petroleum Co.'s coordinator of exploration and production, has been named vice president and a director. Clawson joined Magnolia in Dallas in 1933 after 9 years as a geologist for Indian Territory Illuminating Oil Co. and Lago Petroleum Co. in Venezuela. He was named assistant chief geologist in 1936 and chief geologist in 1946. In 1953 he was promoted to manager of Socony-Vacuum Oil Co.'s Pegasus division in Billings, Mont., and named president of Socony-Vacuum Exploration Co. He also became president of Mobil Producing Co. when that firm was formed in 1955 to take over operations of the Pegasus division. Clawson moved up to coordinator of domestic production for Socony Mobil Oil Co. in January 1956. He transfers back to Magnolia in Dallas from this post.

DEATHS

Frank Wheatley, 77, chairman of the board and former president of Frank Wheatley Pump & Valve Manufacturing Co., died November 26 in Tulsa. He was also an official of Frank Wheatley Supply Co. and Wheatley Equipment & Supply Co., Ltd., Edmonton. Wheatley entered the equipment business in 1905 in Kansas City when he joined Wheatley Brothers Machine Shop. The firm became Wheatley Brothers Pump & Valve in 1916 and began manufacturing oil equipment. Wheatley's operations moved from Kansas City to Tulsa in 1934.

A. F. Shepperd, 72, veteran East Texas oil man, died November 21 in Gladewater, Tex. He was the father of John Ben Shepperd, former Texas attorney general.

Albert R. Jones, 83, Kansas City, president of A. R. Jones Oil & Operating Co., died November 21 in Kansas City. Jones was at one time president of several other oil firms including Mission Oil Co., Lotus Oil Co., and Trojan Oil & Gas.

George T. Koch, Kansas City, retired superintendent of transmission for Panhandle Eastern Pipe Line Co., died November 25 in Kansas City.

C. Earl Blackburn, 47, vice president of the oil and gas division of J. M. Huber Corp. in Borger, Tex., died November 25 in Kansas City. Blackburn was general drilling and production superintendent for Huber before being named a vice president. He was a director of the American Petroleum Institute and of Independent Petroleum Association of America.

Ira G. Watkins, 60, Oklahoma City, owner of Watkins Drilling Co., died November 24 in Oklahoma City after a heart attack.

O. W. (Slim) Sisson, 69, manager of the Oklahoma City store of Larkin Packer Co., Inc., died recently in Oklahoma City. Sisson was with Phillips Petroleum Co. before joining Larkin Packer in 1950.

E. Hammond Jones, 82, San Diego, Calif., partner in the old Palmetto Oil Co., died November 25 in San Diego. Jones was active in the Tulsa area. He moved from Tulsa to San Diego in 1948.

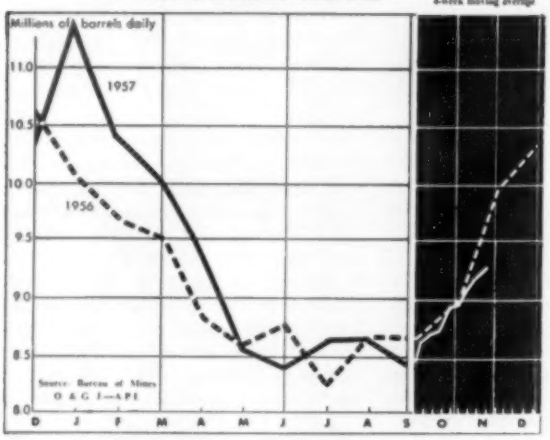
Frank Edward Hart, retired division superintendent for Gulf Oil Corp., died November 25 in Tulsa. He was 64.

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	6,838,325	UP	15,475	DOWN	357,815
Crude stocks	282,086,000	DOWN	2,209,000	UP	1,865,000
Completions	1,015	UP	11	DOWN	23
Refinery runs	7,699,000	DOWN	98,000	DOWN	412,000
Gasoline stocks	183,390,000	UP	912,000	UP	8,846,000
Kerosine stocks	32,942,000	DOWN	561,000	DOWN	3,363,000
Distillate stocks	169,877,000	DOWN	2,063,000	UP	11,006,000
Residual stocks	59,286,000	DOWN	581,000	UP	13,541,000
Four-product stocks	445,495,000	DOWN	2,293,000	UP	30,030,000
Total imports	1,611,900	UP	322,700	UP	201,900

TOTAL DEMAND—ALL OILS



Demand Gains Aid Midwest Distillate Market

SUBSTANTIAL IMPROVEMENT in demand and inventories of distillates at interior points since the first of the month has strengthened supply-demand positions of these products.

Should weather conditions maintain these seasonal increases in consumption in December, the needed higher quotations are expected to materialize in the Middle West and refining areas serving that area.

During the first 2 weeks of the month, distillate stocks in the Oklahoma, Kansas, and Missouri refining area decreased 732,000 bbl. to 13,512,000 bbl., a decline of 5.1 per cent.

For the same period distillate stocks in the Indiana, Illinois, and Kentucky area dropped 1,007,000 bbl. to 23,880,000 bbl., a decline of 4.1 per cent.

These areas were also fortunate in that their distillate stocks at the start of the month were in better positions than the refining industry in general. On November 15 the distillate inventories in the Indiana-Illinois-Kentucky area were 1,512,000 bbl. or 6 per cent less than on the comparable date last year. A decrease of 374,000 bbl., or 2.7 per cent from a year ago in the case of Oklahoma, Kansas, and Missouri pointed to a healthy stock position.

Distillate demands are generally up throughout the United States but unfortunately from the standpoint of the sellers, inventories of several refining areas are still so excessive that there are no indications of price improvement in the immediate future.

Texas and Louisiana Gulf Coast stocks of distillate were down 685,000 bbl. or 3 per cent for the first half of November. But inventories of this product in this area were 4,633,000 bbl. or 19 per cent greater on November 15 than they were on the comparable date last year. As a result spot shipments were freely offered last week for coastwise, export, and domestic movements via the Mississippi River.

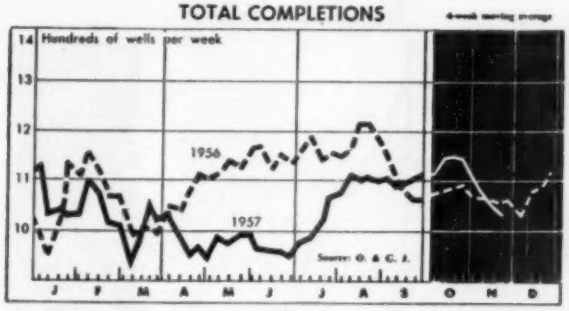
East Coast distillate demands are improving but current supplies are large and stocks the first half of November did not experience the expected decline.

There were no important changes in refinery prices of other products. Some observers feel that the fuel-oil markets centering in the Mid-Continent are improving. There is still some dumping of residual fuel oils in Group 3 in sales to the Gulf Coast for coastwise movement. But the prices reported over the past week were higher than those of the previous week.

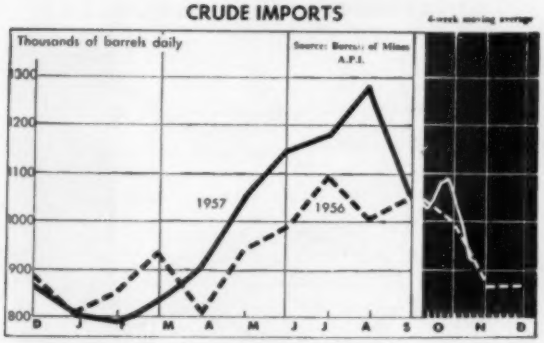
The same situation applies to northern shipments of fuel oil. This market has been dominated by excess supplies at Midwest refineries and also low-priced shipments—sold basis Group 3—coming from Wyoming and Montana refineries.

The weakest markets on all the principal products are in the Gulf Coast. Some of the independent refiners in that area have their storage of crude oil and products filled and in a few instances are reported to have cut their crude runs to stills to their contract requirements for finished products. Because of the reduced refinery realizations, additional refiners in that area are reported seeking concessions in crude-oil prices with some success. Natural gasolines are steady with the strongest position prevailing in the lower-vapor-pressure grades.

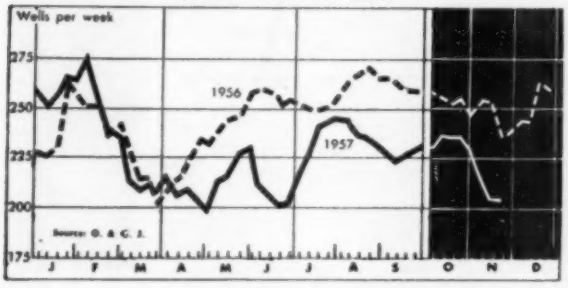
TOTAL COMPLETIONS



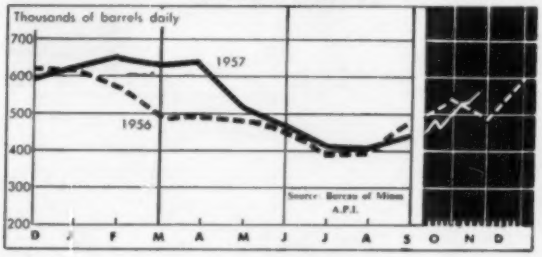
CRUDE IMPORTS



WILDCAT COMPLETIONS



PRODUCT IMPORTS

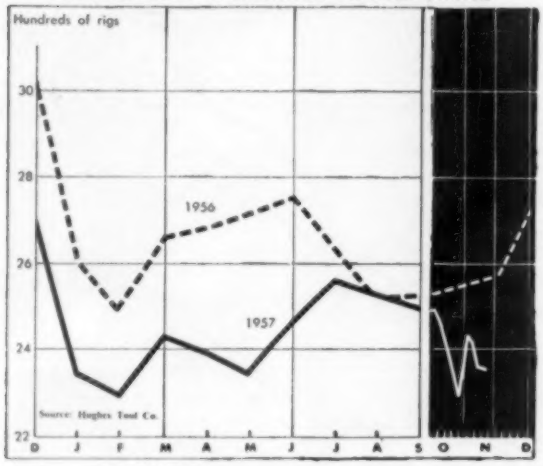


WEEKLY WELL COMPLETIONS . . . WEEK ENDED NOVEMBER 23, 1957

	Total wells							Cumulative		Total wildcats					Cumulative	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1957	1956	Total	Crude	Cond.	Gas	Dry	1957	1956
Alabama	2	1	0	0	1	0	24,821	72	‡101	1	0	0	0	1	25	‡44
Arkansas	23	16	0	0	7	0	65,562	1,005	867	4	1	0	0	3	186	167
California	61	48	0	1	12	0	286,951	2,001	1,995	13	5	0	0	8	473	464
Colorado	20	8	0	3	9	0	104,345	773	1,093	11	4	0	0	7	502	596
Illinois	63	24	0	0	39	0	128,333	2,434	3,530	24	2	0	0	22	577	693
Indiana	22	11	0	0	11	0	36,562	628	546	4	2	0	0	2	120	130
Kansas	90	54	0	8	27	1	353,407	3,795	4,451	13	4	0	1	8	734	966
Kentucky	24	13	0	0	11	0	37,685	1,370	1,728	7	0	0	0	7	281	392
Louisiana	82	33	9	5	35	0	652,794	3,499	3,430	16	1	0	0	15	614	695
North	35	18	0	1	16	0	141,527	1,310	1,507	10	1	0	0	9	182	237
South	37	7	9	3	18	0	417,976	1,574	1,545	6	0	0	0	6	353	391
Offshore	10	8	0	1	1	0	93,281	615	378	0	0	0	0	0	79	67
Michigan	7	3	0	0	4	0	20,504	398	392	2	0	0	0	2	141	149
Mississippi	9	2	0	0	7	0	87,819	350	395	7	0	0	0	7	179	193
Montana	2	0	0	0	2	0	7,951	380	424	0	0	0	0	0	148	164
Nebraska	14	1	0	0	13	0	85,269	805	848	8	0	0	0	8	439	422
New Mexico	35	23	0	7	5	0	178,360	1,937	1,725	2	0	0	0	2	244	246
Northwest	11	3	0	7	1	0	42,536	824	762	0	0	0	0	0	94	87
Southeast	24	20	0	0	4	0	135,824	1,113	963	2	0	0	0	2	150	159
New York	9	4	0	0	0	5	9,250	419	....	0	0	0	0	0	9	....
North Dakota	4	2	0	0	2	0	24,925	263	242	1	0	0	0	1	117	73
Ohio	18	11	0	3	4	0	44,416	1,014	984	0	0	0	0	0	16	12
Oklahoma	99	54	0	8	33	4	347,273	5,673	7,433	14	4	0	2	8	680	783
Pennsylvania	0	0	0	0	0	0	0	571	†966	0	0	0	0	0	41	†31
Texas	375	211	11	17	130	6	1,521,506	19,425	19,754	72	9	0	0	63	4,577	5,035
Dist. 1	20	7	0	0	13	0	30,805	1,111	*2,801	9	0	0	0	9	384	*978
Dist. 2	20	5	2	6	7	0	128,382	700	*2,387	4	0	0	0	4	238	*781
Dist. 3	26	13	3	0	10	0	173,042	1,496	....	4	2	0	0	2	413	....
Dist. 4	21	6	4	0	11	0	102,198	1,256	....	10	3	0	0	7	399	....
East	29	16	1	0	12	0	139,124	1,226	1,059	6	0	0	0	6	343	384
Dist. 7-B	60	22	0	1	36	1	152,787	2,657	....	19	0	0	0	19	895	....
West	116	98	0	4	10	4	517,308	5,503	5,312	8	3	0	0	5	780	827
Dist. 9	67	36	0	2	28	1	205,314	4,204	*7,005	10	0	0	0	10	1,022	*1,951
Dist. 10	16	8	1	4	3	0	72,546	1,272	1,190	2	1	0	0	1	103	114
Utah	11	7	0	0	4	0	58,735	227	128	4	1	0	0	3	114	80
West Virginia	3	0	0	3	0	0	9,040	627	622	0	0	0	0	0	30	20
Wyoming	41	18	0	2	21	0	211,986	783	813	18	3	0	1	14	270	248
Misc. (Nev.)	1	0	0	0	1	0	300	124	71	1	0	0	0	1	106	64
Total U. S.	**1,015**	544	20	57	378	16	4,297,794	48,573	52,638	**222**	36	0	4	182	10,623	11,667
Total prev. week	1,004	465	21	87	413	18	4,094,841	.....	.....	194	16	4	6	168	.....	.....
Cum. 1957	48,573	25,033	544	3,507	18,502	987	201,093,854	.....	.....	10,623	1,072	98	357	9,096	.....	.....
Western Canada	43	24	0	6	13	0	219,551	2,709	2,933	20	4	0	5	11	773	.....

*Districts: 2 & 3, 1 & 4, 9 & 7-B, formerly combined. †Incl. New York. ‡Incl. Florida and Georgia.

ROTARY RIGS OPERATING IN UNITED STATES



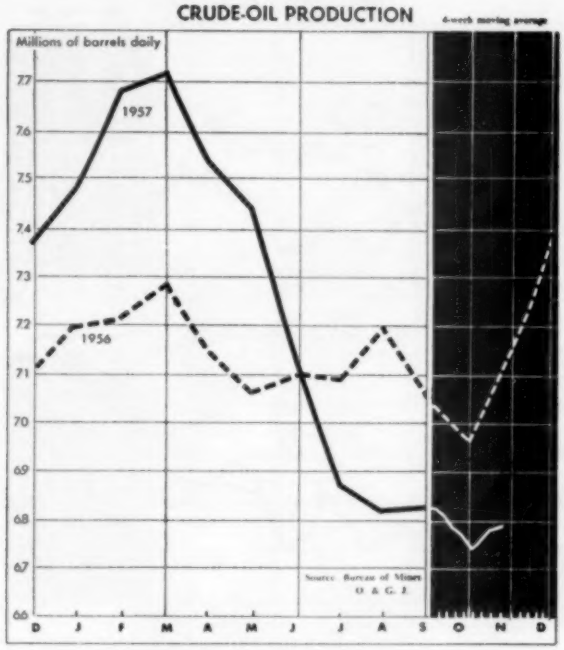
ACTIVE ROTARY RIGS*

Area—	11-25-57	11-18-57	11-11-57	11-26-56
Alabama	7	7	7	9
Arkansas	28	28	24	17
Arizona	1	1	1	....
California	99	89	84	111
Colorado	47	47	52	59
Florida	2	2	1	1
Georgia	....	....	....	....
Idaho	....	....	....	....
Illinois	37	47	65	58
Indiana	8	7	9	10
Iowa	2	2	2	1
Kansas	146	159	160	179
Kentucky	6	8	10	11
Louisiana	389	381	402	478
North	52	53	57	66
South	257	254	260	412
Offshore	80	74	85	(†)
Maryland	....	1	1	....
Michigan	10	9	11	15
Missouri	....	....	....	1
Mississippi	44	47	46	29
Montana	36	34	40	39
Nebraska	25	24	24	27
Nevada	....	....	....	2
New Mexico	149	155	153	125
New York	1	1	1	....
South Dakota	42	39	41	29
Ohio	1	1	1	....
Oklahoma	245	238	249	262
Oregon	....	....	....	....
Pennsylvania	9	12	12	7
South Dakota	2	3	2	1
Texas	888	877	874	1,046
Gulf Coast	173	173	179	260
Offshore	5	5	4	(‡)
West	347	354	358	377
North	317	299	287	343
East	46	46	46	66
Tennessee	....	....	....	....
Utah	55	58	54	27
Washington	1	1	1	1
West Virginia	4	4	4	1
Wyoming	67	75	80	61
Virginia	....	....	....	....
Total United States	2,351	2,357	2,411	2,607
Western Canada	166	184	166	250
Eastern Canada	2	2	2	....
Grand total	2,519	2,543	2,579	2,857

*Hughes Tool Co. †Included with South Louisiana. ‡Included with Texas Gulf Coast.

CRUDE-OIL PRODUCTION

4-week moving average

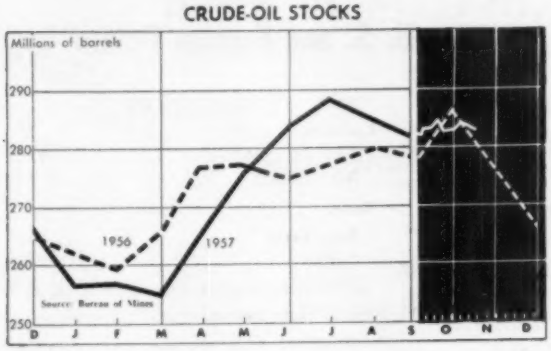


DAILY AVERAGE PRODUCTION FOR WEEK

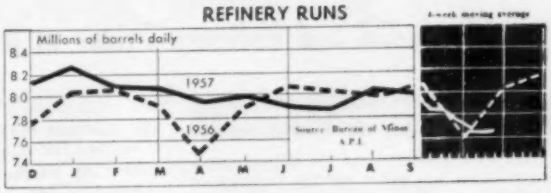
	November 23, 1957			Nov. 16
	Crude oil	Lease condensate	Total	total
Alabama	17,125	.....	17,125	17,250
Arkansas	82,550	200	82,750	80,100
California	926,300	.....	926,300	927,700
Colorado	147,000	.....	147,000	144,750
Eastern	53,100	.....	53,100	53,300
Florida	1,250	.....	1,250	1,250
Illinois	236,600	.....	236,600	226,400
Indiana	32,200	.....	32,200	32,500
Kansas	†334,500	.....	†334,500	†337,800
Kentucky	42,900	.....	42,900	45,300
Louisiana	734,500	82,300	816,800	817,500
North	110,500	2,300	112,800	113,500
South	624,000	80,000	704,000	704,000
Michigan	27,800	.....	27,800	26,500
Mississippi	93,700	4,400	98,100	98,100
Montana	74,000	.....	74,000	76,650
Nebraska	54,600	.....	54,600	55,250
Nevada	150	.....	150	150
New Mexico	248,850	5,500	254,350	254,300
North Dakota	33,200	.....	33,200	27,300
Oklahoma	†571,200	.....	†571,200	†569,500
Texas	2,665,000	56,400	2,721,400	2,721,400
Dist. 1	50,000	525	50,525	50,525
Dist. 2	120,000	9,050	129,050	129,050
Dist. 3	380,000	27,000	407,000	407,000
Dist. 4	198,000	6,350	204,350	204,350
Dist. 5	32,000	450	32,450	32,450
Dist. 6	110,000	6,400	116,400	116,400
East Texas field	162,000	.....	162,000	162,000
Dist. 7-B	143,000	100	143,100	143,100
Dist. 7-C	150,000	3,850	153,850	153,850
Dist. 8	1,010,000	1,500	1,011,500	1,011,500
Dist. 9	207,000	600	207,600	207,600
Dist. 10	103,000	575	103,575	103,575
Utah	12,600	.....	12,600	11,500
Wyoming	300,250	.....	300,250	298,150
Others	‡150	.....	‡150	‡200
Total U. S.	6,689,525	148,800	6,838,325	6,822,850
Change from previous week, up			15,475	
Canada	†433,455	.....	†433,455	†438,870
Total U. S. production, January 1-November 23			2,350,710,825 bbl.	
Same period last year (crude plus cond.)			*2,338,720,935 bbl.	

*Includes 40,408,080 bbl. condensate. †Week ended previous Monday. ‡South Dakota.

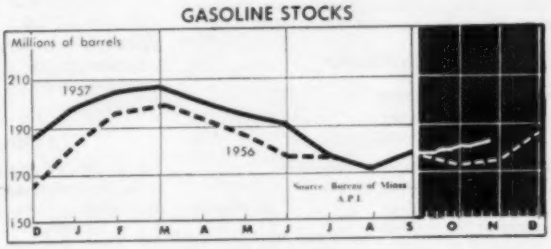
CRUDE-OIL STOCKS



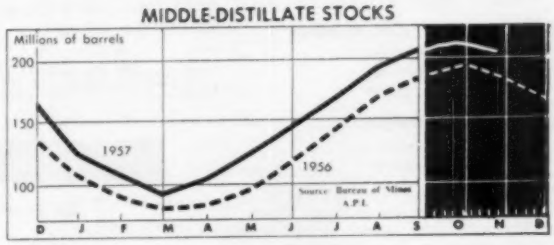
REFINERY RUNS



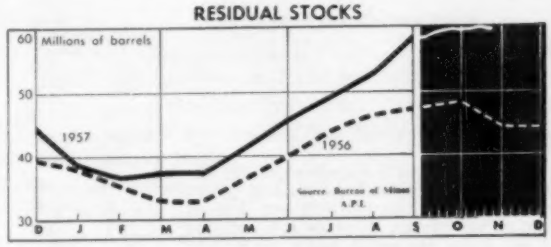
GASOLINE STOCKS



MIDDLE-DISTILLATE STOCKS



RESIDUAL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	11-16-57	11-9-57	11-17-56
Pennsylvania Grade	3,125	3,114	2,419
Other Appalachian	1,866	1,821	2,272
Illinois, Indiana, and Michigan	10,841	11,000	11,568
Nebraska and North Dakota	2,787	2,789	2,518
Kansas	10,600	10,626	10,501
Oklahoma	20,986	21,461	23,907
Arkansas	2,564	2,716	2,907
Louisiana	20,652	20,216	17,626
North	3,388	3,355	2,418
South	17,264	16,861	15,208
Mississippi, Ala., and Fla.	2,560	2,786	3,295
New Mexico	9,479	9,731	8,535
Texas	125,350	125,876	129,524
East Texas	9,723	10,097	8,980
West Texas	55,113	55,504	63,032
Texas Gulf	25,911	25,245	24,293
Other Texas	34,603	35,030	33,219
Wyoming	13,638	14,561	17,111
Other Rocky Mountain	7,344	7,252	6,613
California	32,319	32,199	28,916
Foreign	†17,975	18,147	12,509
Total	282,086	284,295	280,221

*Bureau of Mines. †Includes 6,379,000 bbl. in California.

API REFINERY REPORT, NOVEMBER 22, 1957

(Thousands of barrels)

District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks‡—Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, November 1956—Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
East Coast	1,145	439.1	8.6	306.1	164.7	44,857	13,845	66,816	13,285	1,141	446.6	36.0	310.5	205.0
Appalachian:														
District 1	101	42.0	5.9	25.0	9.9	5,055	633	3,626	632	105	40.9	6.3	27.0	6.3
District 2	114	53.6	10.6	18.4	13.8	2,674	480	1,439	208	101	55.5	6.1	18.7	13.0
Ind., Ill., Ky.	1,487	773.8	72.1	297.9	177.0	30,840	6,894	23,789	6,030	1,429	742.3	78.0	295.3	193.1
Minn., Wis., Dak.	91	43.0	1.6	28.7	7.7	6,742	1,517	8,178	393	100	49.9	8.1	25.5	9.0
Okla., Kans., Mo.	693	397.7	9.7	173.3	32.1	14,625	1,727	13,293	1,159	694	379.0	17.1	176.1	33.8
Inland Texas	263	201.8	8.4	39.3	21.7	6,785	472	2,449	1,845	267	186.1	8.3	54.6	19.5
Texas Gulf Coast	1,728	870.6	113.7	440.0	184.6	24,078	3,400	18,909	7,399	1,960	896.7	135.8	490.8	252.1
La. Gulf Coast	604	345.9	34.0	146.4	48.4	11,024	2,703	9,159	1,446	667	368.9	68.5	165.9	56.1
N. La. and Ark.	100	35.1	8.0	20.3	5.9	4,618	525	2,210	229	103	42.2	9.9	22.2	6.9
Rocky Mountain:														
New Mexico	28	15.6	0.7	5.4	3.6	413	16	112	70	27	13.4	0.6	5.2	3.5
Other Rocky Mtn.	278	134.9	4.1	68.9	32.3	5,596	351	2,852	938	268	136.5	4.4	62.4	37.2
West Coast	1,067	463.3	17.0	164.3	313.6	26,083	379	17,045	25,652	1,170	501.3	4.5	187.3	346.8
Nov. 22, 1957	7,699	3,816.4	294.4	1,734.0	1,015.3	183,390	32,942	169,877	59,286	8,032	3,859.3	383.6	1,841.5	1,182.3
Nov. 15, 1957	7,797	3,836.1	289.4	1,724.9	1,088.3	182,478	33,503	171,940	59,867	.....	.....	.....	.....	.....
Nov. 23, 1956	8,111	3,830.9	407.9	1,823.0	1,208.3	174,544	36,305	158,871	45,745	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (89 octane)	11.50-11.75
Premium (98 octane)	14.25-14.50
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	10.75-11.00
Regular (92 octane)	11.00-11.25
Premium (97 octane)	12.50-12.75
Premium (98 octane)	12.75-13.00
California (rack) (Los Angeles):	
Regular (88 octane)	12.2
Premium (96 octane)	14.8
Premium (98 octane)	15.0
Caribbean area (cargoes):	
Regular (87 octane)	10.625
Premium (93 octane)	11.50

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:	
Grade 26-70	4.5
Breckenridge:	
Grade 26-70	4.0

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16 lb. Prices for grades below 16 lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	9.50-10.00
Diesel oil (58 d.i. and above)	9.125-9.75
Distillate No. 1	9.125-9.75
Distillate No. 2	8.50-9.00
Gulf Coast (cargoes):	
Kerosine 41-43	8.75-9.50
Distillate No. 2	8.75-9.50
New York Harbor (barges):	
Kerosine 41-43	10.75
Distillate No. 2	10.25
Diesel fuel, 48-52 d.i.	10.55
Caribbean area (cargoes):	
Distillate No. 2	9.00

WAX (LB.)

Oklahoma (Group 3):	
132-135 A.m.p. (semi-refined) in tank cars	6.50
New York (export):	
126-130 A.m.p. crude-scale (solid in bags or barrels)	7.35

★Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$1.60-1.80
Gulf Coast (cargoes):	
Bunker C fuel	$2.50-2.75
New York Harbor (barges):	
Bunker C fuel	$2.95
Caribbean (cargoes):	
Bunker C	$2.55
California (rack):	
Bunker C fuel, Los Angeles	$2.85-3.00

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., 95 v.i.	25.5
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	22.25
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	28
200 vis. neutral (180 at 100°), 25 p.t.	26

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour) (§)
14-14.9	$2.67	....	....	....	....
15-15.9	2.71	....	....	....	$1.81
16-16.9	2.74	....	....	....	1.86
17-17.9	2.78	....	....	....	1.91
18-18.9	2.82	....	....	....	1.96
19-19.9	2.85	....	....	....	2.01
20-20.9	2.89	$2.75	....	$2.62	2.06
21-21.9	2.93	2.77	....	2.64	2.11
22-22.9	2.97	2.79	....	2.66	2.16
23-23.9	3.01	2.81	$3.44	2.68	2.21
24-24.9	3.05	2.83	3.46	2.70	2.26
25-25.9	3.09	2.85	3.48	2.72	2.31
26-26.9	3.13	2.87	3.50	2.74	2.36
27-27.9	3.17	2.89	3.52	2.76	2.49
28-28.9	3.22	2.91	3.54	2.78	2.54
29-29.9	3.27	2.93	3.56	2.80	2.59
30-30.9	3.32	2.95	....	2.82	2.63
31-31.9	3.38	2.97	....	2.84	2.67
32-32.9	3.44	2.99	....	2.86	2.71
33-33.9	3.50	3.01	....	2.88	2.75
34-34.9	3.56	3.03	....	2.90	2.79
35-35.9	3.61	3.05	....	2.92	2.83
36-36.9	3.65	3.07	....	2.94	2.87
37-37.9	3.68	3.09	....	2.96	2.89
38-38.9	....	3.11	....	2.98	2.91
39-39.9	....	3.13	....	3.00	2.93
40 and up	....	3.15	....	3.02	2.95

*Includes Oklahoma, part of Kansas, North Dakota, West Texas (sweet) and North Central Texas. †Low cold test Gulf Coast. ‡Sour. §Most buyers are posting Wyoming sour in two schedules, 15°-26.9° and 27°-40°.

Effective dates: California January 17, 1957, east of California, January 3-January 10, 1957; Pennsylvania Grade, July 26, 1957.

FLAT PRICES

Louisiana:	
Bienville (distillate)	$3.05
Ville Platte	3.45
Texas:	
East Texas	3.25
Conroe	3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.65
Middle District	4.47
Southwest Pennsylvania	4.18
West Virginia	4.00
Buckeye Grade	4.00
Zanesville Grade	3.04
Illinois Basin	3.15
Canada:	
Leduc-Woodbend	2.74
Redwater (Alta.)	2.63
Smiley (Sask.)	2.40
Pembina	2.61

FOREIGN

Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.75
San Joaquin, 41°-41.9°, Puerto La Cruz	3.34
Oficina, 35°-35.9°, Puerto La Cruz	3.05
Tia Juana medium, 26.5°-26.9°, Amuay*	2.55
Quiriquire, 16.5°-16.9°, Caripito	2.45
Lagunillas heavy, flat, Amuay or Las Piedras*	2.38
Bachaquero, flat, Las Piedras*	2.23

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
Arabian, 36.0°-36.9°, Ras Tanura	$2.12
Iranian, 34.0°-34.9°, Bandar Masur	2.04
Iranian, 34.0°-34.9°, Abadan	1.99
Iraq, 36.0°-36.9°, Fao	2.00
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.85
Qatar, 41.0°-41.9°, Umm Said	2.23
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.59
Iraq, 36.0°-36.9°, Tripoli, Banias	2.59
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°	2.75

TANKER RATES PER LONG TON

(Latest reported spot fixtures)

★ Gulf-U.S.N.H., dirty (USMC—30%)	$2.00
★ Carib.-U.S.N.H., dirty (USMC—60%)	1.08
★ Carib.-U.K., clean (Scale—35%) (21s. 2d.)	2.96
★ P.G.-Japan, clean (USMC—30%)	6.30

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DRILLING AND PRODUCTION

Title	Price
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Engineering Fundamentals on Petroleum Reservoirs	2.00
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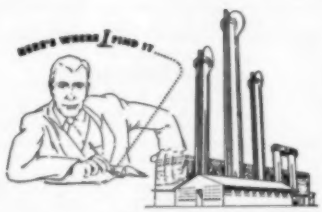

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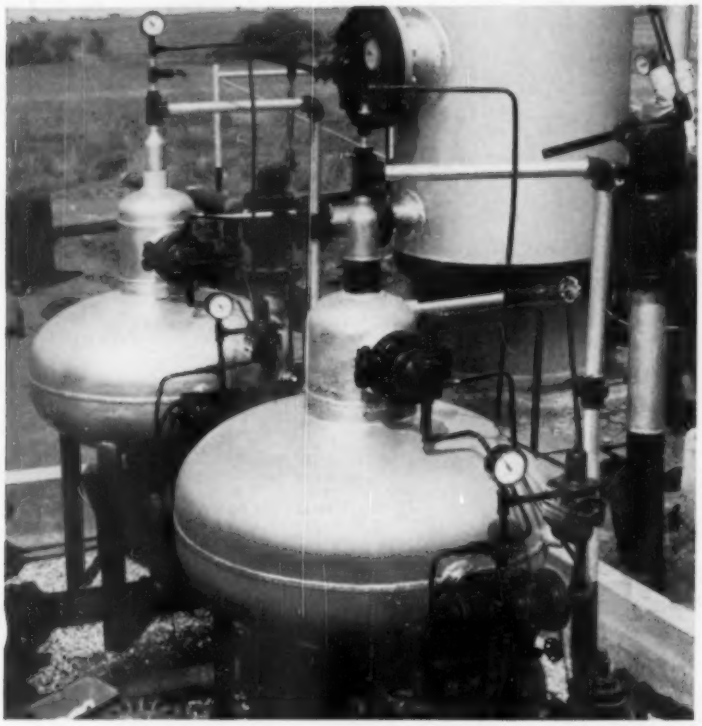
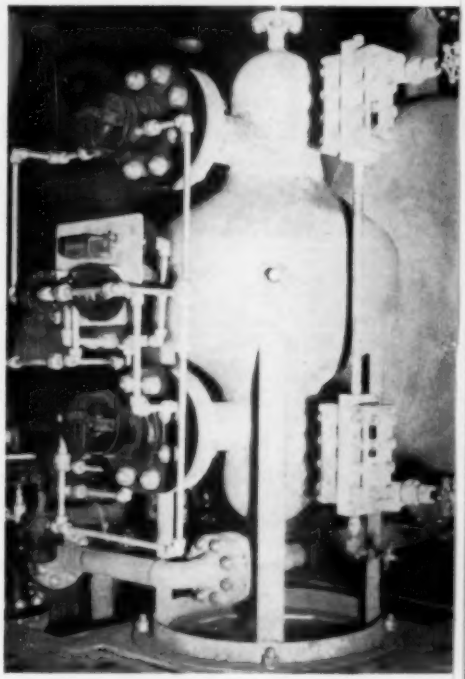
NATIONAL SERAPHIN NECK FLUID METER

For accurate measurement of production from individual wells under a common royalty.

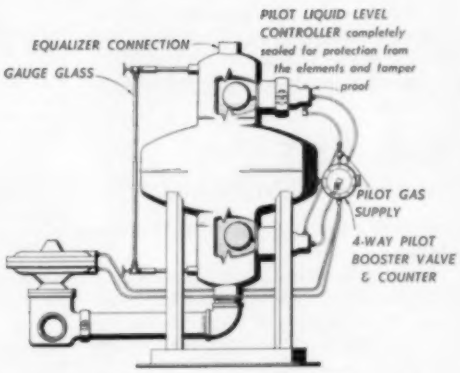


National Seraphin Neck Fluid Meter installation in Southern Oklahoma.



1200 PSI WP National Seraphin Neck Fluid Meter on offshore platform production unit — Louisiana.

1. Reduced liquid surface area holds percentage of metering error to minimum.
2. Greater accuracy provided through two weather-proof, tamper-proof, sensitive liquid level controls.
3. Control booster relay insures fast, positive liquid valve action.
4. Three-way metering valve, readily installed or removed, constructed of materials to give maximum service and positive shutoff.
5. Corrosion resistant trim on valves and controls.
6. All components rust and weather-proofed.
7. Accurate within the limits prescribed by producer, royalty owner and regulatory body for measuring oil to be commingled.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4-WAY PILOT BOOSTER VALVE & COUNTER

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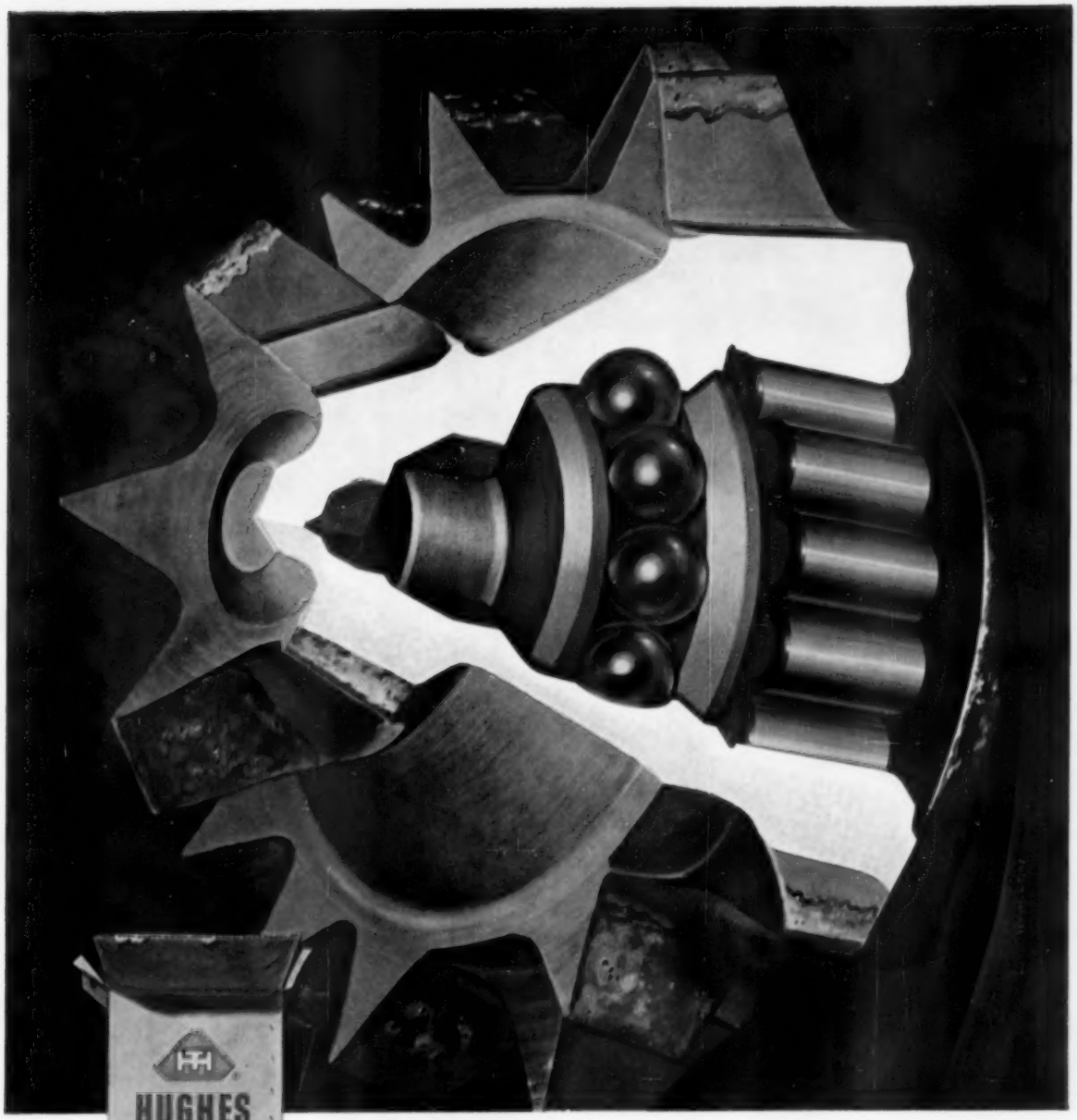

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